HOARE LEA

Proposed Great Wolf Lodge.
Chesterton, Bicester.
Great Lakes UK Limited.

SUSTAINABILITY

ENERGY & SUSTAINABILITY STATEMENT (INCLUDING BREEAM PRE-ASSESSMENT)

REVISION 03 – NOVEMBER 2019

Audit sheet.

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Contents.

Executive summary.

1.1 The Application.

This energy strategy has been prepared on behalf of Great Lakes UK Ltd, hereafter referred to as the Applicant, in support of a full planning application for the Proposed Great Wolf Lodge, Chesterton, Bicester, hereafter referred to as the Proposed Development.

1.2 The proposed development.

The Proposed Development comprises the redevelopment of part of a golf course to provide new leisure resort (sui generis) incorporating waterpark, family entertainment centre, hotel, conferencing facilities and restaurants with associated access, parking and landscaping.

Table 1: Prosed floorspace.

Space Type	Space Use	Floor Area (GIA) m^2
Non-Dwelling	Hotel	27,250 m^2
	Family Entertainment Centre + back of house + conference	12,350 m^2
	Waterpark	8,340 m^2
	Total:	47,940 m^2 (total GEA: 52,685 m^2)

1.3 Drivers.

A summary of planning policy documents applicable to the proposed development include:

National drivers; Approved Document Part L of the Building Regulations.
Part L of the Building Regulations is the mechanism by which government is driving reductions in the regulated CO_2 emissions from new buildings. The assessment of the proposed development against policy targets has been carried out using the Building Regulations Part L 2013.

Carbon factors used within Part L are given in the government's Standard Assessment Procedures (SAP). Updates to the current carbon factors set within Part L 2013 have been issued in the draft SAP 10 guidance in July 2018, providing a great reduction in the carbon content especially for grid electricity, down by 55% from Part L 2013 figures. These updated figures are already in use within London, where the Greater London Authorities have issued guidance confirming a preference for their use since January 2019.

Even greater carbon emissions would be expected by use of very recent updated carbon factors issued on 10/10/2019 in a new draft of SAP 10. This update is so recent as to not be included in this report, but if implemented, this would further bolster the strategy chosen for the Proposed Development.

Cherwell Council Policy.
The following summarises the Cherwell Council Local Plan 2011-2031 for energy and CO_2 emissions: All new developments should:

- reduce carbon emissions and use resources more efficiently, including water (policy ESD 1)
- achieve carbon emissions reductions, by use of an 'energy hierarchy' (ESD 2)
- make use of decentralised and renewable or low carbon energy where appropriate (policy ESD 4)
- implement renewable and low carbon energy provision wherever any adverse impacts can be addressed satisfactorily (ESD 5)

Environmental assessment methodology.
The following summarises the adopted Cherwell policy for the application of environmental assessment methods:

- All new non-residential development will be expected to meet at least BREEAM 'Very Good' (policy ESD 3)

1.4 Approach.

The energy and sustainability strategy for the Proposed Development draws on guidance from the Cherwell Local Plan.

The Energy Strategy takes a holistic approach to energy demand reduction, and carbon emission reductions. Principles of the Energy Hierarchy are followed in terms of ensuring the design is energy efficient prior to incorporation of low and zero carbon energy sources.

Calculations demonstrating the energy requirements and associated CO_2 emissions have been carried out for the Proposed Development using Building Regulations approved software. This has been used to inform the energy strategy for the works.

The Sustainability Strategy responds to National Planning Policy and Guidance, and also makes reference to local policy.

CIBSE Technical Memorandum (TM) 54: Evaluating Operational Energy Performance of Buildings at the Design Stage
Due to the mix of end uses in the development (hotel, waterpark and retail/restaurant-like areas in the Family Entertainment Centre), it was decided by the development team to carry out a bespoke energy modelling exercise in line with CIBSE TM54: *Evaluating Operational Energy Performance of Buildings at the Design Stage.*

This has allowed for a more detailed understanding of actual energy and carbon emission reductions likely to be achieved in the Proposed Development, beyond those calculated in Part L. For example, limitations within the Part L methodology mean that energy and carbon emissions related to unregulated energy uses such as the pool water heating and the laundry water heating are not accounted for – clearly a significant percentage of the energy demand for a development such as Great Wolf.

The results of this assessment have been used to inform the development of the energy strategy.

1.5 Energy Strategy Summary.

Passive design and energy efficiency
The energy demand for the development will be reduced first of all by the implementation of good practice thermal envelope performance values, and energy efficient systems.

Load sharing for Hotel and Family Entertainment Centre (FEC)
This part of the development will have a simultaneous heating and cooling demand throughout the year due to the mix of facilities present. To significantly reduce the energy demand and associated carbon emissions of the development, it is proposed to leverage the opportunity that the simultaneous heating and cooling profile presents.

In summary, an innovative heating and cooling system will be provided to capture heat that would typically be rejected to atmosphere by air-cooled chiller plant during the cooling season; the captured heat will be utilised to contribute towards the constant base heating load that is present throughout the year.

Heating and cooling for Hotel and Family Entertainment Centre (FEC)

In lieu of 'standard' air-cooled chillers, reversible air source heat pumps (RASHPs) will be adopted to generate chilled water during the cooling season, which will be utilised to meet the developments cooling demands.

A water source heat pump (WSHP) will be utilised to capture low-grade heat from chilled water return infrastructure connected to the cooling plant, to prevent the heat from being rejected to atmosphere. The recovered heat will be utilised to contribute towards domestic hot water generation throughout the year, as well as to contribute towards the developments space heating and ventilation system heating requirements during the heating season.

In effect, this process provides the development with 'free heat' that would typically be rejected to atmosphere, under a conventional gas-fired boiler and chiller arrangement.

When the heating demand exceeds the amount of heat recovered from the cooling system, any RASHPs that are not operating in cooling mode will be utilised generate to generate additional LTHW.

These systems will be supplemented by gas-fired condensing boilers when necessary to meet the remaining peak demand.

The LTHW heating system will be designed to operate with low flow and return temperatures, to maximise the efficiency of the RASHP's and WSHP, and to ensure that when operational, the gas-fired boilers operate continuously in condensing mode, maximising heating system efficiency.

Waterpark

Conventionally, the waterpark heating demand would be met through the adoption of gas-fired boilers. There will be no mechanical cooling requirement for the waterpark (dehumidification requirements will be met through the ventilation system alone).

To maximise the extent of carbon reduction across the development, a dedicated air source heat pump (ASHP) installation will be provided to act as the lead heat source for the waterpark, with gas-fired boilers provided to act as the secondary heat source during peak demand periods.

As with the hotel and FEC design, the waterpark heating system with be designed to operate with low flow and return temperatures, to ensure that the efficiency of the ASHP is maximised, and the gas-fired boilers (when operational) operate in condensing mode, further improving heating system efficiency.

1.5.1 Energy and carbon reduction summary

The adoption of the above heating and cooling system strategy will result in significant overall energy and carbon savings across the development, when compared to a 'base scheme' energy strategy which represents conventional systems for this type of development, and which is compliant with Part L of the Building Regulations, which would include:

- A refrigerant based hybrid VRF system to heat and cool the hotel, with gas-fired water heaters utilised to generate domestic hot water.
- Gas-fired boilers and air-cooled chillers to heat and cool the Family Entertainment Centre, with the gas- fired boilers also utilised to generate domestic hot water and temper fresh air supplied by mechanical systems.
- Gas fired boilers for the waterpark to generate heating and hot water including pool water heating.

The carbon emission reduction potential associated with the strategy set out above is expected to be substantial, especially when considering 'real' current carbon emission factors rather than the outdated Building Regulations factors.

In addition, as the electricity grid continues to be decarbonised, the electrically-led holistic heating and cooling system proposed for Great Wolf will result in even lower carbon emissions in the future.

Current estimated carbon emission reductions are given in the adjacent Figure 1 to Figure 4.

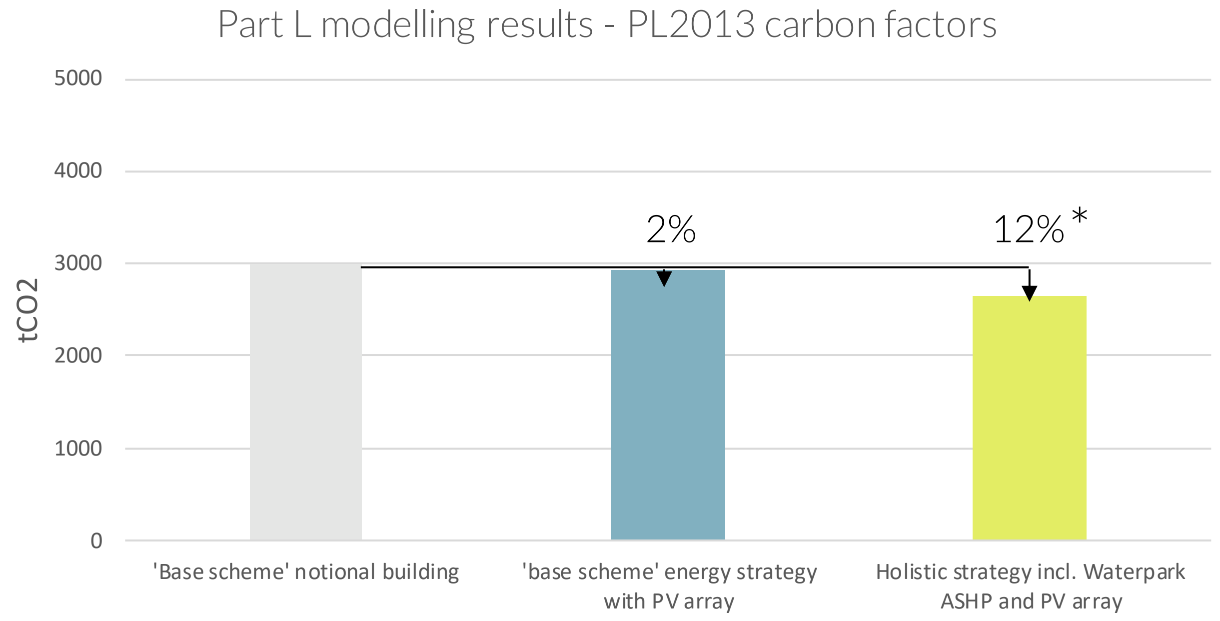

Figure 1: Part L modelling results using Part L 2013 carbon factors
*) Results are compared against a 'base scheme' which assumes a traditional energy strategy approach using boilers and chillers, and which is compliant with Part L 2013. Please refer to sections 2.2 & 7.2 for further detail.

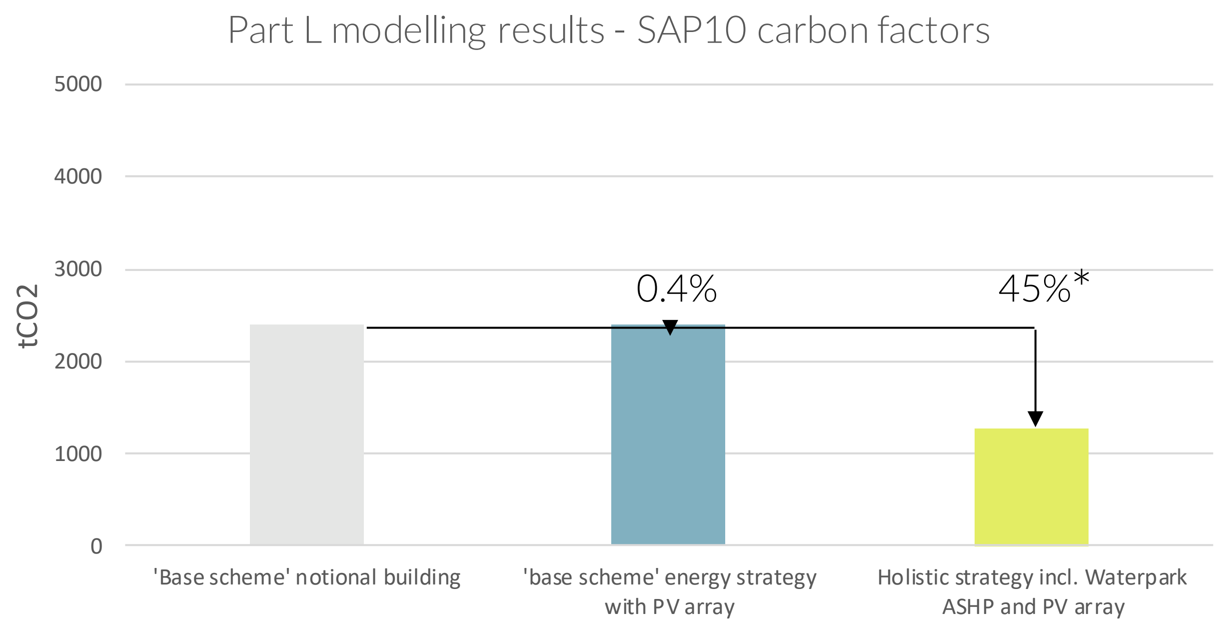

Figure 2: Part L modelling results using SAP 10 carbon factors.
*) As above, results are compared against a 'base scheme'. Please refer to sections 2.2 & 7.2 for further detail.

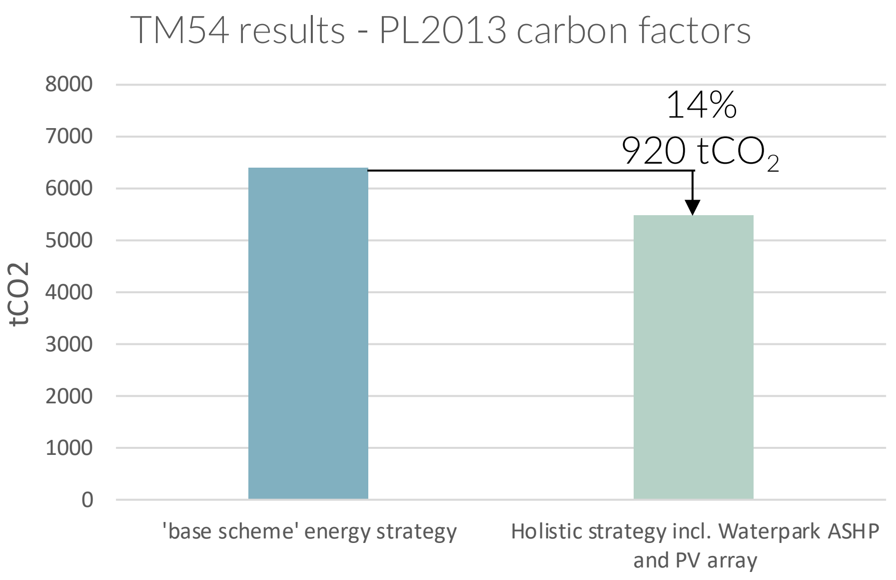

Figure 3: CIBSE TM54 (operational energy performance evaluation) modelling results using Part L 2013 carbon factors

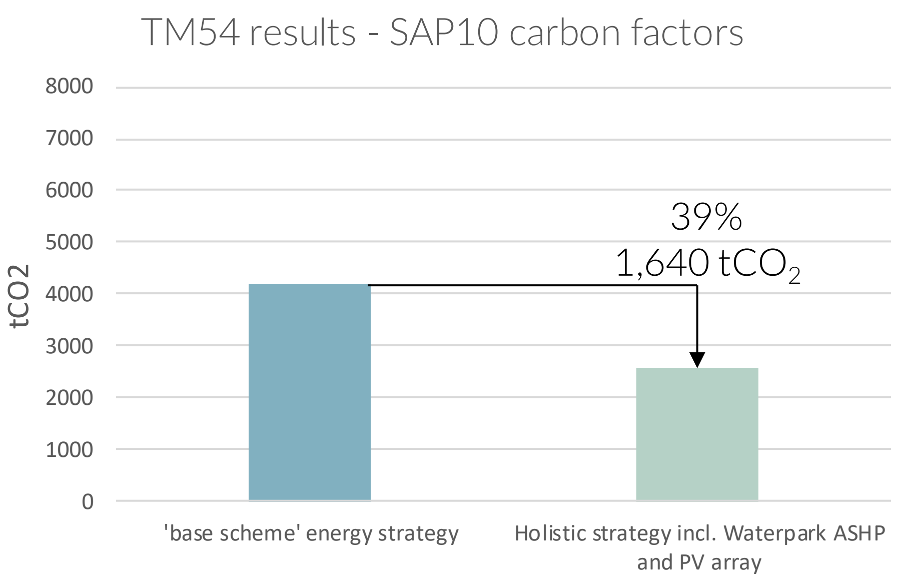

Figure 4: CIBSE TM54 (operational energy performance evaluation) modelling results using SAP 10 carbon factors

1.6 District energy connection and combined heat and power (CHP)

Due to the significant decarbonisation of the electricity grid over recent years, the implementation of a combined heat and power installation will achieve a worse result in terms of carbon reduction when compared against other heat generating technologies, when the comparative heating systems are assessed against the current more realistic SAP10 carbon emissions factors. CHP relies on the discrepancy between electricity and gas carbon emission factors to achieve carbon savings; a discrepancy which has now all but disappeared with SAP10 carbon factors. Furthermore, CHP engines are not efficient when compared against other heat generating technologies, are complex to run efficiently and maintain, and emit elevated NOx emissions resulting in adverse air quality within the vicinity of their installation.

Currently, there are no known district networks in the local vicinity that are sited in a location that would make connection viable from a carbon reduction perspective. The North West Bicester Eco Town (known as Elmsbrook) incorporates district energy; however, the Phase 1 site is located approx. 3 miles from the Proposed Development as the crow flies.

District heating systems can result in significant distribution losses via the buried infrastructure associated with energy distribution (i.e. below ground pipework). Therefore, distributing heating energy over large distances is often less efficient in terms of carbon reduction than providing an efficient on-site generation strategy. District energy networks are ideally suited to urban areas with significant heat density.

Further, the Elmsbrook site implements CHP, and it is therefore likely this will be less carbon efficient than the systems proposed for the Great Wolf development at the outset, when taking into account the decarbonisation of the electricity grid. Please refer to Appendix 3 for further detail on the relative merits of electrically led strategies compares to gas-fired systems as a result of the electricity grid decarbonisation.

The proposed holistic energy strategy will result in a significant reduction in carbon emissions when compared to an alternative installation utilising a CHP installation, when assessing the equivalent carbon emissions using current realistic carbon emission factors. A CHP is therefore not proposed for the development.

1.7 Renewable energy technologies

A feasibility options appraisal has been carried out which found heat pumps were the most suitable and commercially viable low or zero carbon technology, as described in previous sections. Please refer to section 6of this report for further detail.

In order to further reduce carbon emissions, it is envisaged that a 1,000m^2 PV array (PV panel area), equivalent to 150 kWp output, will be provided on the south-facing pitched waterpark roof (i.e. an optimum location).

The location and quantum of PV panels has been carefully selected to maximise energy provision and provide an array which can be maintained, and which protects drivers on the M40 from potential glare.

1.8 Sustainability Measures.

Water.

The developer, an established water park operator and who has knowledge and expertise in water efficient technologies, will invest in the adoption of regenerative media filter technology (i.e. 'Defender' filters) in lieu of industry standard 'deep bed medium rate sand filters', in order to considerably reduce the amount of water required for the backwash process, saving an estimated 28,800,000 litres potable water per annum.

The Development will be fitted with water efficient fixtures and fittings, and water meters will be provided to enable the monitoring of water consumption.

The Development is targeting potable water reduction equivalent to a 40% reduction compared to the BREEAM 2018 'baseline' for credit Wat 01.

Mains water metering will be incorporated in the design, as well as sub-meters to water-consuming plant or building areas consuming 10% or more of the building's total water demand. Meters will be connected to the central Building Management System.

A leak detection system capable of detecting a major water leak will be installed on the utilities water supply to detect any major leaks within the building, as well as between the buildings and the utilities water supply.

The current surface water drainage scheme includes permeable sub-bases, swales, storage ponds and attenuation tanks to control the stormwater run-off from the site. It is proposed that water will be pumped from the main below ground surface water attenuation tank to serve toilet/WC cisterns in hotel rooms via a day tank and appropriate water filtration and treatment equipment.

It has been estimated that the provision of the described surface water attenuation system could reduce annual water consumption in the hotel alone by circa 13,860,000 litres per annum.

Irrigation

The parkland style to the landscape integrated around much of the site will comprise native trees, woodland, grassland and wildflower meadow that will not require watering once established, as these species will be selected to ensure they are tolerant of natural seasonal conditions. Ornamental planting will be used sparingly but will also largely comprise of native species, along with species tolerant of varying UK weather conditions, to minimise the requirement for watering following establishment.

Occasional watering would be required during the first 5 years of establishment to all areas of new planting, which will be provided by bowser, fed from existing waterbodies in the wider parkland. It is anticipated that no mains cold water will be required for irrigation purposes across the site.

Please refer to the Outline Water Resources Scoping Note prepared by Hoare Lea for further information.

Materials.

Consideration will be given to the lifecycle of building elements, with the aim of specifying materials which have environmental product declarations (EPDs) where feasible. Additionally, all timber will be legally harvested and sourced, and it is an aim that all timber used at the Development will be FSC or PEFC certified (or similar) and where possible, other materials will be responsibly sourced.

Materials will aim to be 'low emissions', through achieving low volatile organic compound (VOC) levels where feasible, to assist in providing a good indoor air quality at the Proposed Development.

An assessment of the lifecycle impact of the development materials has been undertaken, comparing options for a number of key building elements.

Waste.

A Resource Management Plan (similar to a site waste management plan) will be developed for the construction phase to outline opportunities for waste management and ensure good practice will be adopted in the construction phase of the Proposed Development.

The Proposed Development will be constructed in a manner which aims to protect the environment and local community through reusing, recycling and recovering waste which would otherwise be disposed of at landfill.

The Proposed Development will include three main waste stores; a store for food waste, a store for recyclable waste and an area for a compactor for refuse.

Operational waste will be segregated into glass bottles, cardboard & paper, and Dry Mixed Recycling (DMR), which would comprise items such as plastic bottles, plastic packaging, and metal cans. A glass crusher will also be provided in the waste store to reduce the volume of glass for collection. Waste stores will be clearly labelled to ensure cross contamination of all waste streams is minimised. All waste storage areas will be built to BS 5906:2005 standards.

Proposed locations where the Refuse Collection Vehicles would park when emptying bins have been designed so that collection operatives will not be required to transport the bins a greater distance than 10 metres.

Please refer to the Waste Management Strategy, prepared by WSP, for further information regarding operational waste management proposals.

Sustainable Transport.

Pedestrian and cycle access to the site will be taken from the A4095 via the main site access.

As part of the development proposals a new footway will be provided along the southern side of the A4095 from the site to Chesterton and will connect with the existing footway provision at the junction between the A4095 and The Hale. In addition, the proposed footway will continue west along the frontage of the site and extend as far as the existing public right of way path.

It is further proposed to provide a shuttle bus service between the resort and Bicester. The shuttle bus service will be available for guests and staff to use, free of charge. It is also intended that the shuttle bus will be available to residents of Chesterton, also free of charge.

For guests to the resort the shuttle bus service will connect the resort with local trains stations; both Bicester Village and Bicester North. In addition to the proposed guest shuttle bus service, it is proposed to provide a separate shuttle bus service for staff at the resort and it is intended that this service will also be available to residents of Chesterton. It is envisaged that the staff shuttle bus service will likely call at local stations, the town centre and local centres around Bicester.

It is proposed that a total of 902 car parking spaces will be provided on site for use by guests and staff. A total of 56 disabled accessible parking bays will be provided on site, equating to 6% of total parking provision. The proposed disabled accessible parking provision exceeds the requirements of Traffic Advisory Leaflet 5/95 and accords with good practice guidance in BS8300.

Charging facilities for electric vehicles will be provided for 10% of the total number of car parking spaces (90 spaces total).

Secure cycle storage will be provided at the Development to maximise the potential for sustainable transport to and from the building for day guests and staff. In total, 80 cycle spaces, of which 40 will be allocated as 'short stay' (for day guests), and 40 will be 'long stay' (for staff).

A Framework Travel Plan has also been produced for the Proposed Development, setting out a long-term strategy to inform staff and visitors of the travel choices available to them and to encourage sustainable modes of travel, in particular public transport, walking and cycling.

Please refer to the Transport Assessment and Framework Travel Plan, prepared by Motion, for further details.

Ecology and biodiversity.

Extensive work has been carried out with regards safeguarding and improving ecology and biodiversity on site.

The majority of the Site is currently of low biodiversity value, comprising approximately 67% amenity grassland The Proposed Development aims to enhance the majority of the existing amenity grassland to semi-improved neutral grassland. The remaining areas of site will comprise the hotel complex and associated hardstanding and landscape planting. Existing waterbodies, woodland and hedgerows will be retained and enhanced where possible.

No irreplaceable habitat or statutory designated sites are directly impacted by the Proposed Development. Under current landscape plans, the Proposed Development would result in an overall net gain (+31%) in area-based biodiversity units, with no area-based HPI habitat lost. There would be a net gain of linear units generated by hedgerow HPI (+316%) and running water (+14%).

Although there is a net loss in three woodland habitat types (broadleaved parkland/scattered trees, coniferous parkland/scattered trees and mixed parkland/scattered trees), the Proposed Development has achieved net gain for similar habitat types: mixed plantation woodland and broadleaved plantation woodland. Consequently, the Proposed Development does achieve an overall biodiversity net gain.

Elements of the existing / retained and proposed landscape will be managed as part of a coordinated maintenance strategy to ensure its successful establishment and long-term sustainability and a Landscape Management & Maintenance Plan is included as part of this planning application.

Please refer to the Ecological / Biodiversity Assessment prepared by WSP and the Landscape Management & Maintenance Plan prepared by Bradley Murphy Design for further information.

Pollution.

Consideration will be given to the reduction of pollution from a number of sources, such as, but not limited to:

- Construction site generated pollution (e.g. dust)
- Indoor Air Quality
- Ground pollution
- Water pollution
- External Lighting – minimising spill of light
- Noise and vibrations (achieving Part E of Building Regulations)

The Building Research Establishment's Environmental Assessment Method - BREEAM.
In order to demonstrate the sustainability credentials of the building, the Proposed Development is undertaking certification with the Building Research Establishment Environmental Assessment Method, and is targeting a rating of Very Good under the BREEAM New Construction 2018 scheme.

A pre-assessment for the project has been carried out and a summary is provided in Appendix 2. In order to achieve a Very Good rating a score of 55% is required, as well as all related mandatory credits achieved.

The current pre-assessment predicts a baseline score of 60.9%, i.e. a margin above the required minimum score for 'Very Good' of 5.9%.

A number of additional potential credits have been identified and will be explored during detailed design in order to safeguard the targeted rating against any future design changes or unforeseen site constraints.

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2. Introduction.

2.1 The proposed development.

The Proposed Development comprises the redevelopment of part of golf course to provide new leisure resort (sui generis) incorporating waterpark, family entertainment centre, hotel, conferencing facilities and restaurants with associated access, parking and landscaping

This building will contain 498 hotel rooms. Attached will be the family entertainment centre which will include restaurants, retail and entertainment areas. The third part of the development will be a waterpark. The development will also contain amenity areas such as a conference centre, and wellness facilities such as a gym. The development is supported by servicing, landscaping works, provision of utilities and other supporting infrastructure.

The Site is located approximately 500m to the west of the centre of Chesterton village.

The location of the Proposed Development is shown in Figure 5.

Figure 5: Site location. Source: EPR

2.2 Approach to energy strategy reporting.

The Proposed Energy Strategy takes a holistic approach to energy demand reduction, and associated carbon emission reductions.

The proposed development will target a reduced effect on climate change by reducing CO_2 emissions associated with energy use in line with national and local policy.

The holistic energy strategy proposed has been compared to a 'base scheme' energy strategy which represents conventional systems for this type of development, and which is compliant with Part L of the Building Regulations.

A comparison has been made using both Part L (Building regulations compliance) and CIBSE TM54 (operational energy performance evaluation) methodologies in order to gain a detailed understanding of real expected energy and carbon emission reductions for the scheme. Please refer to section 3.4 for further details of the differences between these methodologies.

The Sustainability Strategy responds to National Planning Policy and Guidance, and also makes reference to pertinent local and regional policies and guidance.

Principal targets:

- Maximisation of energy efficiency features and the integration of load sharing, as well as renewable and low carbon energy technologies
- Carbon reductions:
  - Building Regulations Part L methodology:
    - 12% reduction in carbon emissions* (Part L 2013 carbon factors)
    - 45% reduction in carbon emissions* (SAP10 carbon factors)
  - CIBSE TM54 (operational energy performance evaluation) methodology:
    - 14% reduction in carbon emissions (Part L 2013 carbon factors)
    - 39% reduction in carbon emissions (SAP10 carbon factors)
- A BREEAM New Construction (NC) 2018 rating of 'Very Good'

***A note on Part L methodology**

For clarity, it is highlighted that the reported results show the expected carbon emission reductions when comparing the proposed holistic design with the 'base scheme' building as described in sections 3.5 & 3.6.

When the holistic energy strategy is modelled using Part L calculation methodology (i.e. heat pumps are implemented as described within this report), the calculation methodology assesses the building against a comparative building which also incorporates heat pump technology, known as the notional building'. The heat pumps within the notional model have pre-defined efficiency values (which are lower than the efficiency values of the heat pumps proposed for the proposed development).

The carbon reduction associated with the implementation of the holistic energy strategy will therefore appear lower than reality on the resulting BRUKL Output Document (i.e. Part L calculation output), as the holistic scheme will have been reviewed against a comparative heat pump scheme, as opposed to the actual base scheme (which incorporates gas-fired boilers in lieu of heat pumps). The resulting holistic energy strategy BRUKL Output Document is therefore currently expected to show a 7% reduction in carbon emissions, as opposed to 12% reduction as identified above.

2.3 Drivers.

A summary of planning policy documents applicable to the proposed development are detailed within this section.

2.3.1 National policy

Building Regulations: Approved Document Part L

Approved Document Part L (2013, England edition) is the Building Regulation relating to the conservation of fuel and power in buildings. The Approved Document is separated into two sections: Part L1 and Part L2. Part L1 relates to dwellings and Part L2 relates to buildings other than dwellings.

Part L of the Building Regulations is the mechanism by which government is driving reductions in the regulated CO_2 emissions from refurbished, change of use and new buildings. For new buildings Part L has five key criteria which must be satisfied as follows:

Table 2: Part L criteria.

Criterion 1	Achieving the Target Emission Rate (TER) The calculated CO_2 emission rate for the building known as the Building Emission Rate (BER) or Dwelling Emission Rate (DER) must not be greater than the Target Emission Rate (TER).
Criterion 2	Limits on Design Flexibility The performance of the building fabric and the heating, hot water and fixed lighting systems should achieve reasonable standards of energy efficiency.
Criterion 3	Limiting the Effects of Solar Gains Demonstrate that the building has appropriate passive control measures to limit solar gains within occupied areas.
Criterion 4	Quality of construction and commissioning It must be shown through further calculation at construction stage that the actual performance of the building will be no worse than is expected during the design.
Criterion 5	Providing information Sufficient information must be provided to the building users to enable the building to be run as efficiently as possible.

Criterion 4 and 5 are typically addressed towards the end of construction.

As the Great Wolf Lodge is a new, non-residential development, the applicable Building Regulations Approved Document is Part L2A.

Electricity grid decarbonisation

Recent progress in the energy sector has seen emissions associated with electricity consumption reduce drastically, however this is not reflected in the current Building Regulations which were last updated in 2013. National policy is unlikely to be updated before 2020, increasing the gulf between compliance and current CO_2 intensity.

The CO_2 factor for grid-supplied electricity in current Building Regulations (2013) is 0.519kgCO_2/kWh; as shown in Figure 6, this is a fair reflection of the performance of the grid at that time. However, in response to legally-binding targets established in line with the Paris Agreement, significant progress has been made in decarbonising the electricity grid over the past six years.

Current draft guidance set within the governments Standard Assessment Procedures (SAP10) is proposing a reduction in the carbon factor for grid electricity 10 to 0.233kgCO_2/kWh; a 55% reduction compared to that in Part L 2013[1].

The consequence of this is a discrepancy between emissions calculated using current building regulations methodology from electrical plant and any technologies which offset grid electricity (such as solar PV) compared to the reality of their performance. In a compliance-led world, buildings are being specified with technologies with the objective of reducing CO_2 emissions which, in fact, may not offer any real benefit at all.

Further detail is provided in Appendix 3.

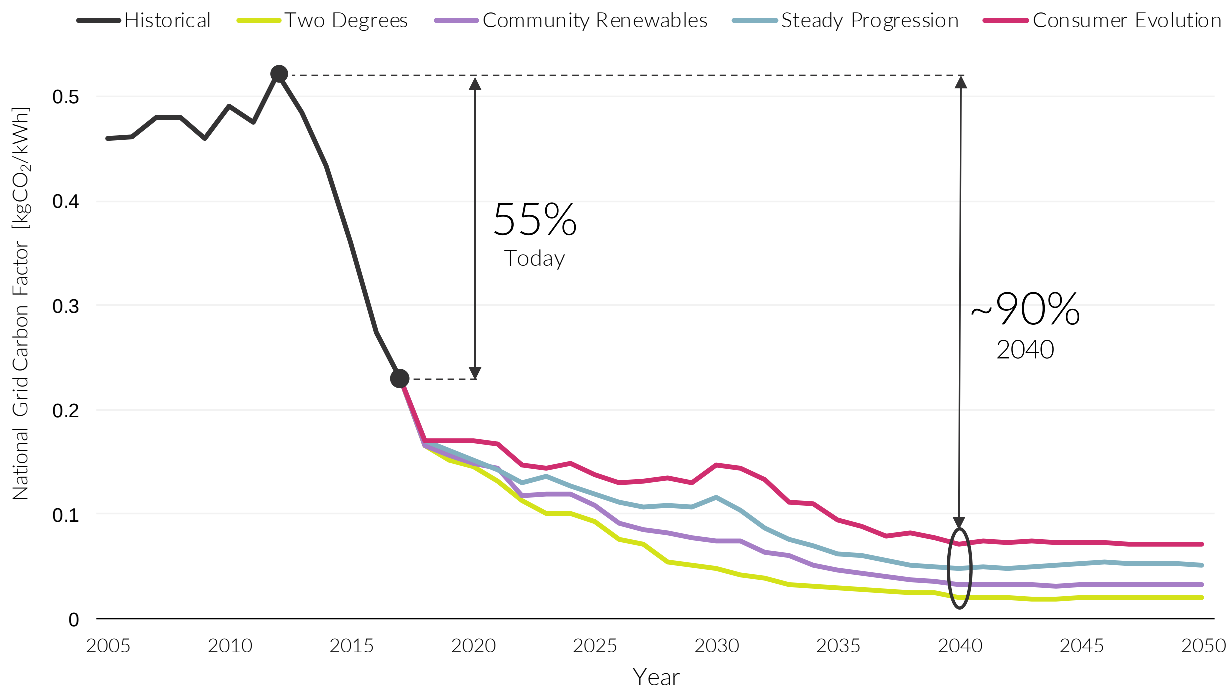


Figure 6: Historic and future projected carbon factor for the National Grid

[1] A very recent update to the draft SAP10 documentation which was issued on 10/10 2019 by the Building Research Establishment sets the carbon content for grid electricity even lower at 0.136 kgCO_2/kWh; a 73% reduction compared to that in Part L 2013

2.3.2 Local policy

Cherwell Local Plan 2011-2031

Table 3 presents a summary of the key targets and requirements found in Cherwell's Local Plan Strategy with regards to energy and sustainability.

Table 3: Summary of local policies for energy and CO_2 emissions.

	Cherwell Local Plan Strategy 2011-2031
ESD 1	Mitigating and Adapting to Climate Change – Design developments to reduce carbon emissions and use resources more efficiently, including water – Reduce the need to travel and encourage sustainable travel options including walking, cycling and public transport – Promote use of decentralised and renewable or low carbon energy where appropriate
ESD 2	Energy Hierarchy and Allowable Solutions Achieve carbon emissions reductions, by use of an 'energy hierarchy' as follows: – Reduce energy use, in particular by the use of sustainable design and construction measures – Supplying energy efficiently and give priority to decentralised energy supply – Make use of renewable energy – Make use of allowable solutions
ESD 3	Sustainable Construction – Achieve BREEAM Very Good – Minimise both energy demand and energy loss (in line with ESD 2) – Maximise passive solar lighting and natural ventilation – Maximise resource efficiency – Incorporate the use of recycled and energy efficient materials and locally sourced building materials – Reduce waste and pollution and make adequate provision for the recycling of waste – Make use of sustainable drainage methods – Reduce the impact on the external environment and maximise opportunities for cooling and shading (by the provision of open space and water, planting, and green roofs, for example)
ESD 4	Decentralised Energy Systems The use of decentralised energy systems, providing either heating (District Heating(DH)) or heating and power (Combined Heat and Power (CHP)) will be encouraged in all new developments.
ESD 5	Renewable Energy The Council supports renewable and low carbon energy provision wherever any adverse impacts can be addressed satisfactorily. The potential local environmental, economic and community benefits of renewable energy schemes will be a material consideration in determining planning applications.

Comparison to other, nearby, recent planning applications

A comparison has been made to the energy and sustainability strategy for other recent nearby planning applications:

Bicester Motion:

- The scheme is similar in terms of use of the building to the Great Wolf Lodge, and therefore the mix of energy uses would be similar also, with a thermally led profile.
- The development has not undertaken an operational energy assessment as part of the planning application, and therefore has not shown the same level of detail as the Great Wolf Lodge in assessing real expected energy consumption.
- The use of CHP shows carbon reductions only when using Part L 2013 carbon factors, which we know to be outdated in reality.
- Although the carbon reduction is shown as 20%, and albeit we expect this was correct and based on the best available information at the time of that planning submission, the current reality is that implementation of CHP would no longer result in carbon emission reductions compared to a baseline scheme using just gas fired boilers.

Holiday Inn Express, Bicester Gateway

- The scheme is similar in terms of use of the building to the hotel areas of the proposed Great Wolf Lodge, and therefore the mix of energy uses would be similar also, with a thermally led profile.
- The development has not undertaken an operational energy assessment as part of the planning application, and therefore has not shown the same level of detail as the Great Wolf Lodge in assessing real expected energy consumption and carbon emissions.
- The use of CHP shows carbon reductions only when using Part L 2013 carbon factors, which are known to be outdated in reality. However, the use of heat pumps for heating and cooling would be expected to show better performance against Part L when using updated carbon factors. Therefore, over-all, the strategy might result in a similar performance with updated carbon factors, compared to the results given in the application.
- When comparing total carbon emissions estimated from the Part L results like for like (i.e. comparison of Part L 2013 BRUKL results), the Holiday Inn Express is expected to emit 61.9 $kgCO_2/m^2yr$. The proposed holistic energy strategy for Great Wolf shows estimated carbon emissions of 52.7 $kgCO_2/m^2yr$ – approx. 15% less than the Holiday Inn Express, year on year.

Premier Inn – Bicester: 57 bedroom extension

- The scheme is similar in terms of use of the building to the hotel areas of the proposed Great Wolf Lodge, and therefore the mix of energy uses would be similar also, with a thermally led profile.
- The development has not undertaken an operational energy assessment as part of the planning application, and therefore has not shown the same level of detail as the Great Wolf Lodge in assessing real expected energy consumption and carbon emissions.
- When comparing total carbon emissions estimated from the Part L results like for like (i.e. comparison of Part L 2013 BRUKL results), it is noted that the Premier Inn extension is expected to emit 71.1 $kgCO_2/m^2yr$. The proposed holistic energy strategy for Great Wolf shows estimated carbon emissions of 52.7 $kgCO_2/m^2yr$ – approx. 26% less than the Premier Inn extension, year on year.

Please refer to Appendix 4 for further details.

3. Energy Strategy.

3.1 Definitions.

The following definitions should be understood throughout this strategy:

- Energy demand – the 'room-side' amount of energy which must be input to a space to achieve comfortable conditions. In the context of space heating, this is the amount of heat which is emitted by a radiator, or other heat delivery mechanism.
- Energy consumption – the 'system-side' requirement for energy (fuel). In the context of a space heating system using a gas boiler, this is the amount of energy combusted (e.g. gas) to generate useful heat (i.e. the energy demand).
- Regulated CO_2 emissions – the CO_2 emissions emitted as a result of the combustion of fuel, or 'consumption' of electricity from the grid, associated with regulated sources (those controlled by Part L of the Building Regulations).

3.2 Energy Hierarchy.

The Energy Strategy takes a holistic approach to energy demand reduction, and carbon emission reductions. Principles of the Energy Hierarchy are followed in terms of ensuring the design is energy efficient prior to incorporation of low and zero carbon energy sources.

Figure 7: The Energy Hierarchy

The strategic approach to the design of the Development has been to reduce demand for energy prior to the consideration of integrating Low or Zero Carbon (LZC) technologies, since controlling demand is the most effective way of reducing energy requirements and CO_2 emissions.

Further reductions are ensured through the specification of high-efficiency building services to limit losses in energy supply, storage and distribution.

After the inclusion of passive design and energy efficiency measures, various options have been investigated to reduce CO_2 emissions associated with energy supply.

The feasibility of LZC technologies has been investigated in line with the policy aspirations and as part of the Energy Strategy submitted in support of the application.

The following sections detail the passive design and energy efficiency measures that have neem considered, and those that will be implemented at the Proposed Development.

3.3 Carbon Factors.

To reflect the changing carbon factors as described in 2.3.1 above, the CO_2 emission factors set out in Table 4 below have been used to convert the energy consumption figures for the development into CO_2 emissions.

Two emission factors are reported on: Part L 2013 (in line with current building regulations, but with known outdated carbon factors, especially for grid electricity), and SAP 10 (expected upcoming building regulations, as reported in draft Part L guidance, with more realistic carbon factors).

It should be noted here that SAP 10 carbon factors are already in-use in London, where the Greater London Authority has issued planning guidance confirming the preference for these since January of this year (2019).

Fuel	Emission Factor, Part L 2013 ($kgCO_2/kWh$)	Emission Factor, SAP 10 ($kgCO_2/kWh$)
Gas	0.216	0.210
Electricity	0.519	0.233*

Table 4: Building Regulations Part L 2013 CO_2 Emission Factors, and draft SAP10 carbon factors, known to be better aligned with reality

*) Further updated carbon factors have been issued on 10/10/2019, showing an even lower value for grid electricity (0.136 gCO_2/kWh).

3.4 CIBSE Technical Memorandum (TM) 54: Evaluating Operational Energy Performance of Buildings at the Design Stage

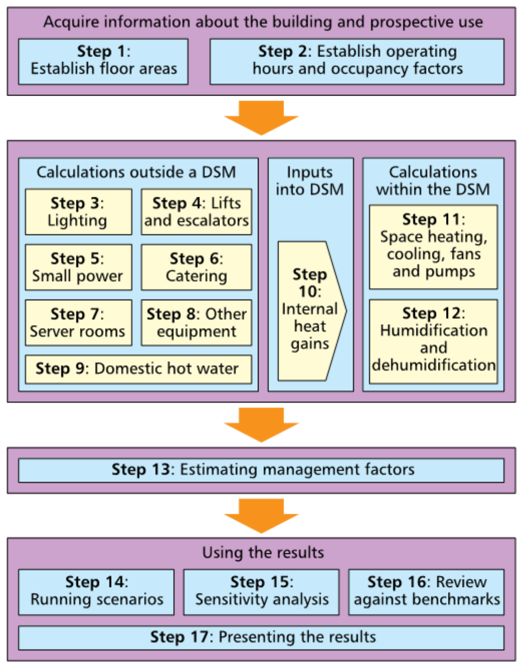
Due to the mix of end uses in the development (hotel, waterpark and retail/restaurant-like areas in the Family Entertainment Centre), and the significant amount of unregulated energy uses expected in the water park and laundry areas especially, it was decided by the development team to carry out a bespoke energy modelling exercise in line with CIBSE Technical Memorandum 54 (2013 version) *Evaluating Operational Energy Performance of Buildings at the Design Stage*.

This has allowed for a more detailed understanding of actual energy and carbon emission reductions likely to be achievable for the development, beyond those calculated in Part L. For example, limitations within the Part L methodology mean that energy and carbon emissions related to the pool water heating are not accounted for – clearly a significant percentage of the energy demand for a development such as Great Wolf.

Key benefits of adopting TM54 methodology compared to Part L for the Proposed Development:

- Unregulated energy uses such as pool water heating, laundry water heating, lifts, and external lighting are included in the TM54 model
- The TM54 methodology allows for flexibility to input actual estimated occupancy profiles rather than relying on pre-defined profiles set by the methodology (as is the case for Part L)
- The TM54 methodology allows for inputs of actual estimated internal gains rather than relying on pre-defined profiles set by the methodology (as is the case for Part L)

Figure 8 provides a simple 'work flow' diagram of the TM54 modelling process. This approach was taken for this TM54 assessment for the Proposed Development.



The energy performance summarised in this report must not be taken as an accurate prediction. The purpose of these calculations is to provide a more appropriate estimate of energy usage to help identify and explain the factors which affect the operational energy use.

The results of this assessment have been used to inform the development of the energy strategy.

Results using the TM54 methodology are reported against both sets of carbon factors as set out in Table 4 above.

Figure 8: CIBSE TM54 Workflow (CIBSE TM54)

Unregulated Energy.
Unregulated energy includes small power electricity use (computers, plug in devices) and catering energy consumption. Currently, unregulated energy is not included within the Part L assessments but as shown in Figure 3, can form a significant part of overall energy consumption and CO_2 emissions from developments. Unregulated energy demands are included within the TM54 methodology, and are also assessed within environmental assessment methods such as BREEAM.

Reductions in unregulated energy use will be implemented where possible, with focus especially on the laundry white goods, which are expected to account for the largest contribution to these.

Further, the Proposed Development will endeavour to include the use of energy efficient appliances such as:

- A / A+ and above rated white goods (EU Energy Efficiency Labelling Scheme)
- Energy star rated small power equipment
- Energy efficient transportation systems
- Voltage optimisation and power factor correction.

Unregulated energy uses are included in the CIBSE TM54 assessment methodology, but not in the Part L methodology.

3.5 Understanding the energy demand for the Proposed Development

In terms of energy demand, the Proposed Development contains three main use types:

- Hotel areas
- Family Entertainment Centre (FEC) and ancillary areas including conference suite.
- Waterpark

An overview of the expected energy demand for each of these use types is given in Figure 9 below.

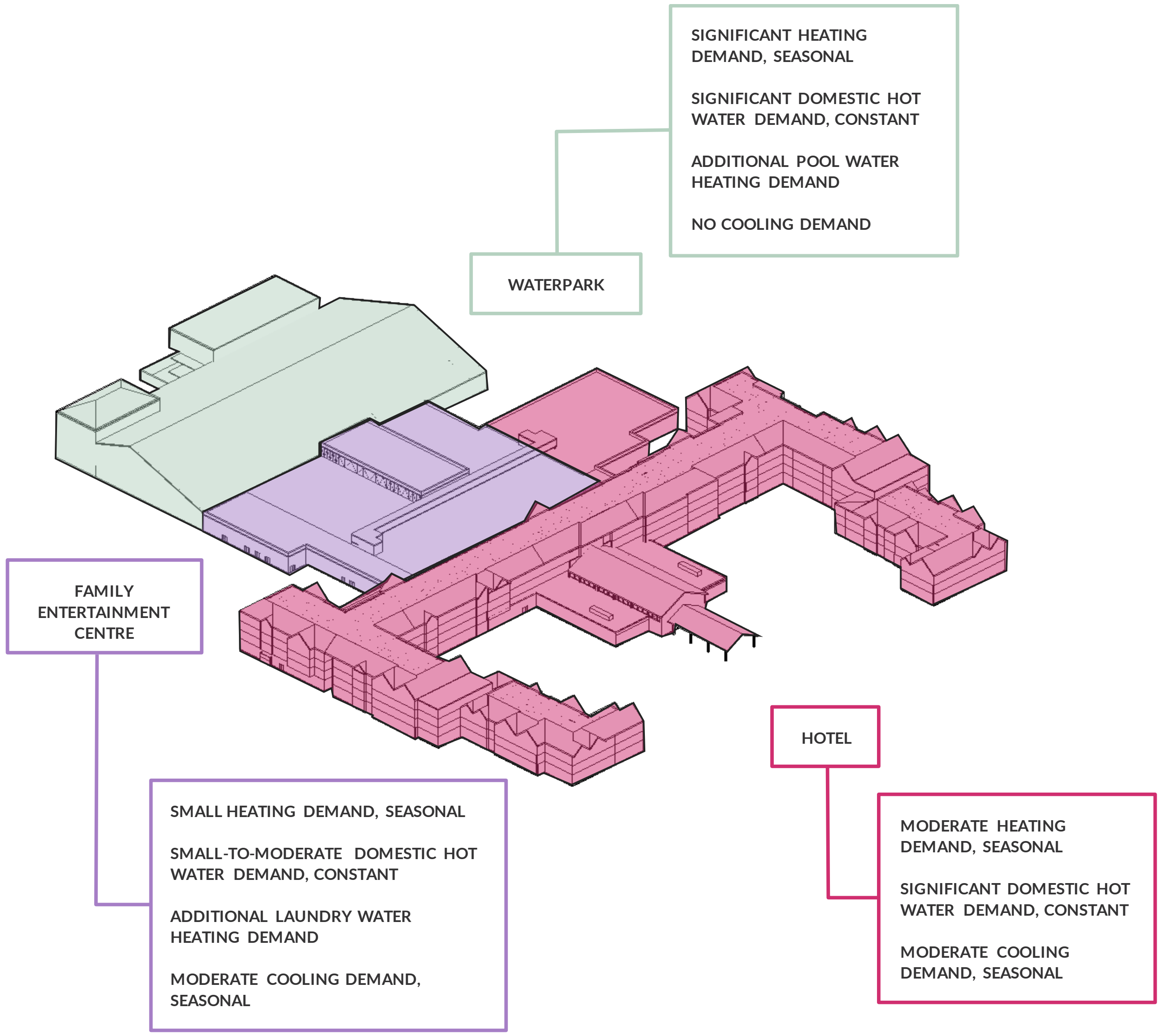


Figure 9: Overview of expected energy demand for each of the main energy 'use types' within the Proposed Development

3.6 Base Scheme energy demand

Results in this energy strategy have been compared against a 'base scheme' energy strategy which represents conventional systems for this type of development, and which is compliant with Part L of the Building Regulations. This base scheme incorporates the following systems:

- A refrigerant based hybrid VRF system to heat and cool the hotel, with gas-fired water heaters utilised to generate domestic hot water.
- Gas-fired boilers and air-cooled chillers to heat and cool the Family Entertainment Centre, with the gas- fired boilers also utilised to generate domestic hot water and temper fresh air supplied by mechanical ventilation systems.
- Gas fired boilers for the waterpark to generate heating and hot water including pool water heating

The base scheme energy strategy is illustrated in Figure 10 below.

The design response to reducing energy demand and carbon emissions for the Proposed Development is described in the following sections.

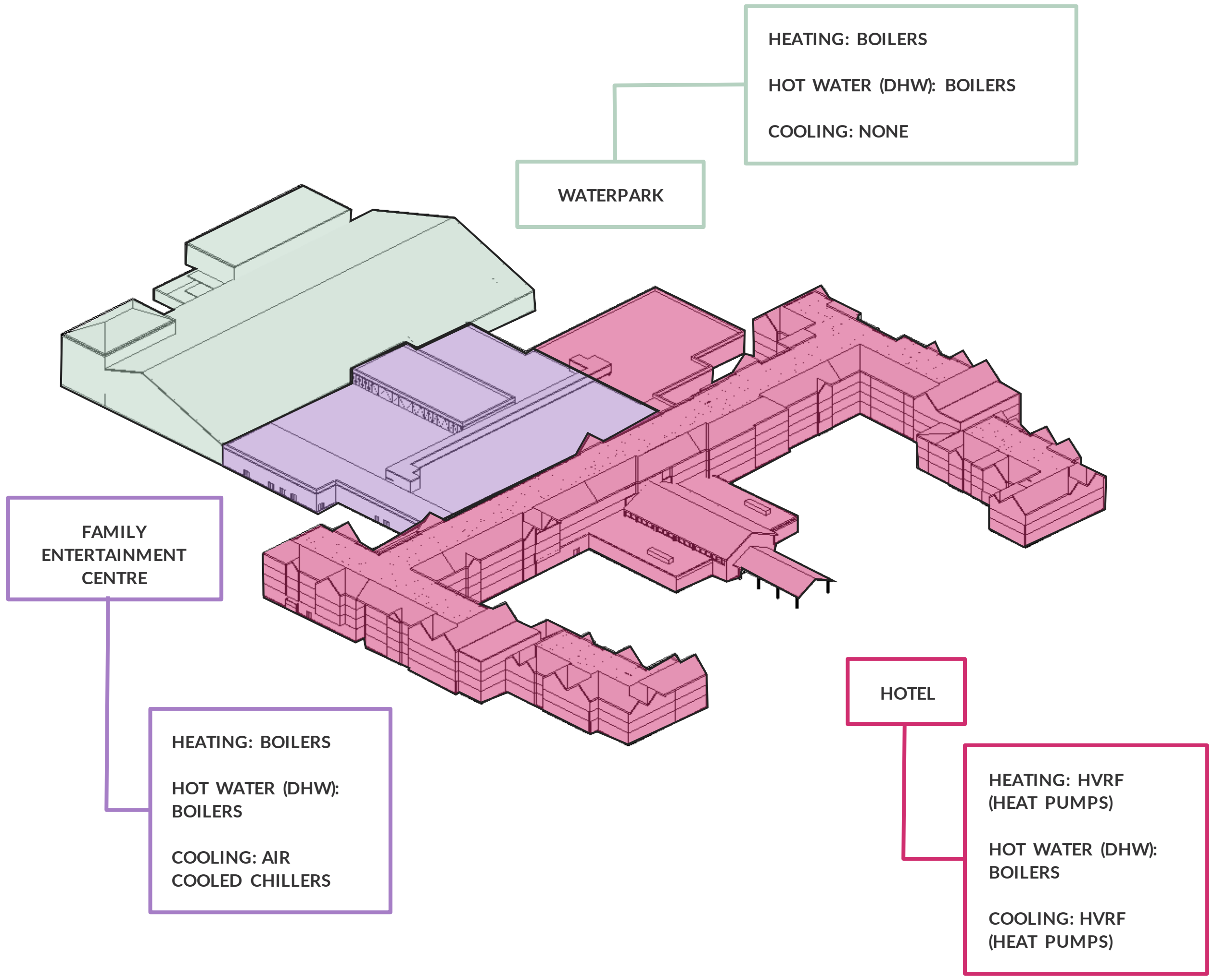
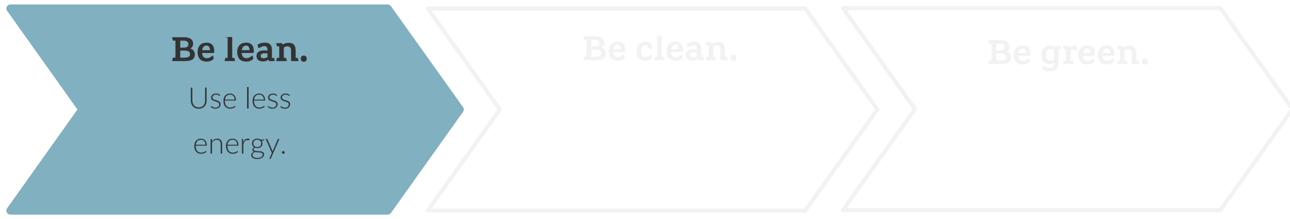


Figure 10: Base scheme systems, representing a conventional energy strategy for this type of development

4. Be lean.

Passive design and energy efficiency measures form the basis for the reduction in overall energy demand and CO_2 emissions for the proposed development. This energy strategy aims to reduce the energy demand initially by optimising the envelope and building services within the development.



Passive design and energy efficiency features.
Passive Design measures are those which reduce the demand for energy within buildings, without consuming energy in the process.

These are the most robust and effective measures for reducing CO_2 emissions as the performance of the solutions, such as wall insulation, is unlikely to deteriorate significantly with time, or be subject to change by future property owners. In this sense, it is possible to have confidence that the benefits these measures will continue at a similar level for the duration of their installation.

Fabric performance.
A 'fabric first' approach has been taken in order to reduce the energy demand and CO_2 emissions from the proposed development. The overriding objective for the façade design of each element of the Proposed Development will be to achieve the optimum balance between providing natural daylighting benefits to reduce the use of artificial lighting, the provision of passive solar heating to limit the need for space heating in winter and limiting summertime solar gains to reduce space cooling demands.

Thermal Insulation
The proposed development will benefit from an efficient thermal envelope. Heat losses and gains will be controlled by the optimisation of the fabric of the development. Reducing the thermal transmittance of the building envelope where appropriate will help to reduce both heating and cooling requirement and result in lower energy requirements.

Glazing Energy & Light Transmittance
In designing the elevations with a moderate approach to fenestration, the design team has focused to ensure a balance between the benefits of passive solar heating in winter months whilst limiting the likelihood of high internal temperatures in summer.

Space heating, space cooling, and load sharing.

Hotel and Family Entertainment Centre (FEC)
This part of the development will have a simultaneous heating and cooling demand throughout the year due to the mix of facilities present, as demonstrated by the estimated load profile – see Figure 11 adjacent. It is proposed to leverage the opportunity that the simultaneous heating and cooling profile presents to significantly reduce the energy demand and associated carbon emissions of the development.

In summary, an innovative heating and cooling system will be provided to capture heat that would typically be rejected to atmosphere by air-cooled chiller plant during the cooling season. The captured heat will be utilised to contribute towards the constant base heating load present throughout the year.

In lieu of air-cooled chillers, reversible air source heat pumps (RASHPs) will be adopted to generate chilled water during the cooling season, which will be utilised to meet the developments cooling demands. The RASHP installation will be sized to meet the peak cooling demand of the development.

A water source heat pump (WSHP) will be utilised to capture low-grade heat from chilled water return infrastructure connected to the cooling plant, to prevent the heat from being rejected to atmosphere. The WSHP will elevate the low-grade heat from the cooling circuit return infrastructure to a viable temperature (i.e. turning it into low temperature hot water, LTHW), which will be distributed to a thermal store. The recovered heat will be utilised to contribute towards domestic hot water generation throughout the year, as well as to contribute towards the developments space heating and ventilation system heating requirements during the heating season.

In effect, this process provides the development with 'free heat' that would typically be rejected to atmosphere, under a conventional gas-fired boiler and chiller arrangement.

When the development heating demand exceeds the amount of heat recovered from the cooling system, any RASHPs that are not operating in cooling mode will be utilised to generate additional LTHW to meet the heating demand.

When the heating demand exceeds the available heating output of the WSHP and RASHP installation, gas-fired condensing boilers will be utilised to meet the remaining peak demand.

The LTHW heating system will be designed to operate with low flow and return temperatures, to ensure that when operational to maximise the efficiency of the heat pumps, and ensure the gas-fired boilers operate continuously in condensing mode, maximising heating system efficiency.

A concept schematic for the Holistic Energy Strategy mechanical systems is provided in Appendix 5.

The adoption of the above heating and cooling system strategy will result in a significant overall energy and carbon savings across the development, when compared to an equivalent 'base scheme'.

The 'base scheme' represents an alternative conventional heating and cooling strategy that would be typically be adopted to service this type of development, and includes:

- gas-fired boilers and air-cooled chillers to heat and cool the Family Entertainment Centre, with the gas- fired boilers also utilised to generate domestic hot water and temper fresh air supplied by mechanical ventilation systems.
- a refrigerant based hybrid VRF system to heat and cool the hotel, with gas-fired water heaters utilised to generate domestic hot water for the hotel.

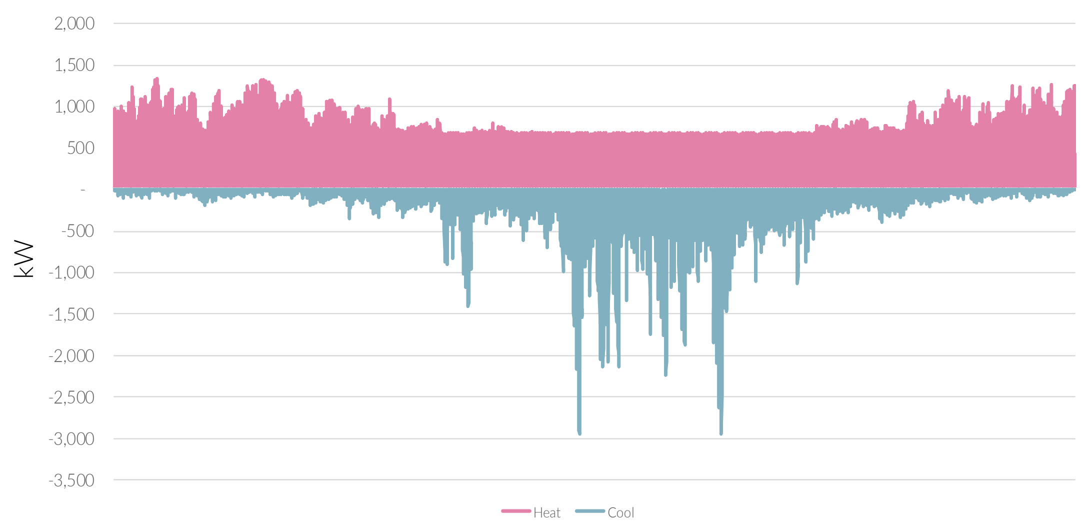


Figure 11: Benchmark heating and cooling load profiles for the hotel and FEC

Waterpark
Conventionally, the waterpark heating demand would be met through the adoption of gas-fired boilers. There will be no mechanical cooling requirement for the waterpark (dehumidification requirements will be met through the ventilation system alone).

To maximise the extent of carbon reduction across the development, a dedicated air source heat pump installation will be provided to act as the lead heat source for the waterpark, with gas-fired boilers provided to act as the secondary heat source during peak demand periods.

As with the hotel and FEC ASHP installation, the waterpark heating system with be designed to operate with low flow and return temperatures, to ensure that the efficiency of the heat pump is maximised, and the gas-fired boilers (when operational) operate in condensing mode, further improving efficiency. A concept schematic for the Water Park mechanical systems is provided in Appendix 5.

Mechanical ventilation.
All areas will be provided with ventilation rates in accordance with Building Regulations Part F, whether this is through Mechanical Ventilation with Heat Recovery, mechanical extract only or natural ventilation.

Mechanical ventilation with heat recovery is an important addition to the building services to maintain good indoor air quality by providing fresh air to the occupied areas of the and extracting vitiated air from areas where necessary (e.g. bathrooms and kitchens). Providing fresh air minimises the risk of stale air and limits the risk of condensation and mould growth. Coupled to a heat exchanger, the warmth in extracted air can be recovered and delivered to the supply air. Thus, mechanical ventilation with heat recovery reduces space heating demand.

Domestic hot water (DHW) system.
The hotel and FEC 'heat pump lead' holistic heating and cooling system requires low temperature hot water to be generated at lower flow and return temperatures than conventionally provided (i.e. a maximum of 50 degree flow temperature in lieu of 70 degree flow temperature), which in intern results in a requirement to generate and distribute domestic hot water at lower flow temperatures than traditionally provided (i.e. circa 48 degrees as opposed to 60 degrees).

Storing and distributing domestic hot water at reduced temperatures results in a requirement to provide suitable water treatment systems in order to mitigate against the significant risks associated with the proliferation of pathogenic bacteria such as Legionella, E.Coli and Pseudomonads which can occur at reduced domestic hot water temperatures. Chlorine dioxide water treatment systems are recognised by the Health & Safety Executive's publication 'HSG 274', and are therefore proposed to be adopted to mitigate against the identified risks.

Additionally, all spaces will include the use of water-efficient fixtures and fittings including WCs with low flush volume, flow restrictors in the taps of wash hand basins and aerated shower heads, to limit overall water consumption in line with Building Regulations Part G.

The development is targeting to achieve 3 credits under the BREEAM 'Wat 01' credit issue, equivalent to a 40% saving in regulated water consumption compared to the BREEAM 2018 baseline.

Natural daylight and lighting strategy.
The development will be provided with low-energy, efficient light fittings throughout.

In the context of retail especially (in the Family Entertainment Centre), lighting tends to provide a significant contribution to regulated CO_2 emissions. As such, the implementation of energy efficiency lighting design is paramount to reducing overall emissions for these spaces, and for the proposed development as a whole. The Proposed Development will be supplied with efficient electric lighting that could include 'Compact Fluorescent Lamps' (CFL), 'Light Emitting Diodes' (LED) or similar.

The lighting specification for the proposed development will be carried out in conjunction with lighting control systems incorporating daylight linkage and presence detection.

External lighting will also be energy efficient and will be linked to daylight sensors and / or presence detectors to prevent unnecessary use.

As well as reduced energy requirement that will be achieved by implementing these strategies, the contribution to the cooling requirements and internal heat gains will be reduced. This will further reduce the total energy requirements and CO_2 emissions of the Proposed Development.

Summary of passive design and energy efficiency measures.

Table 5 summarises the passive design and energy efficiency measures that are proposed to be implemented in the design of the Proposed Development, and sets out the inputs used in the Base Scheme model as well.

Parameter	Base Scheme model	Hotel and FEC areas target (holistic strategy)	Targeted for Waterpark areas
Roof U-value (W/.m^2.K)	0.18		
Floor U-value (W/.m^2.K)	0.18		
External Wall U-value (W/.m^2.K)	0.18		
Glazing/curtain walling U-value (W/.m^2.K)	1.6		
Glazing g-value	0.4		
Fabric Air Permeability (m^3/(m^2.h) at 50Pa)	3		
Space Heating efficiency (COP)	VRF: 4.67 (hotel bedrooms) Gas Boiler: 95% (all other areas)	WSHP: 4.5 RASHP 3.59 Gas boiler 95%	ASHP: 3.35 Gas boiler: 98%
Cooling SEER	VRF: 5.14 (hotel bedrooms) Chillers: 5.13 (all other areas)	WSHP: Energy from heat rejection* RASHP: 4.04 Total overall value used in model: 10.63*	No cooling
Example lighting efficacies (W/m^2.100lux)	As per the holistic strategy inputs	2.0 (guest rooms) 3.0 (kitchens) 2.6-2.8 (circulation) 2.2-2.4 (plant/BOH) 2.4 (laundry)	1.7
Example lighting controls	Guest rooms: Manual switching via Energy Saver Unit Stairs: PIR detection; Offices: Absence detection WCs / Changing / BOH Circulation: Presence switching External: photocell + time clock All other areas: Manual switching		
Example ventilation SFP (W/l/s)	As per the holistic strategy inputs	1.6 (system fans) 0.25 (terminal fans) OR 0.5 (extract only)	1.6
Heat recovery efficiency (%)	As per the holistic strategy inputs	80%	67%
Metering & Controls	To enable at least 90% of end use energy to be accounted for.		

Parameter	Base Scheme model	Hotel and FEC areas target (holistic strategy)	Targeted for Waterpark areas
Power Factor Correction	>0.95		
Lighting monitoring	Auto monitoring & targeting with alarms for out of range values.		
Pipework & Ductwork Insulation	To be provided in accordance with the Building Regulations.		
O&M Manuals	To be provided in accordance with the Building Regulations.		

Table 5: Summary of Passive Design and Energy Efficiency Measures.

*) Although the output of 'free energy' from the system will in reality be in the form of heat rejected from the cooling system, due to technicalities of the modelling, the element of 'free energy' is instead accounted for in the cooling system input.

5. Be clean.

This stage of the energy hierarchy refers to the use of heat networks or on site Combined Heat and Power (CHP) in order to provide energy and reducing consumption from the national grid and gas networks, through the generation of electricity, heating and cooling on-site.

Be lean. | **Be clean.** Supply energy efficiently. | Be green.

5.1 Development demand.

A significant proportion of the proposed development's energy demand is expected to be heat. This includes both domestic hot water and space heating. The ambition is to supply thermal energy with systems that will reduce CO_2 emissions and provide users with cost effective and reliable access to heat.

5.2 Be clean: network and technologies.

In line with policy aspirations, the following sections summarise the considerations of the low-carbon energy supply measures that have been considered.

Heat and energy networks.

Offsite heating network

Currently, there are no known district networks in the local vicinity that are sited in a location that would make connection viable from a carbon reduction perspective.

The North West Bicester Eco Town (also known as Elmsbrook) incorporates district energy; however the phase 1 site is approx. 3 miles from the Great Wolf development as the crow flies.

District heating systems can result in significant distribution losses via the buried infrastructure associated with energy distribution (i.e. below ground pipework). Therefore, distributing heating energy over large distances is often less efficient in terms of carbon reduction than providing an efficient on-site generation strategy. District energy networks are ideally suited to urban areas with significant heat density.

Further, the Elmsbrook site implements CHP, and it is therefore likely this will be less carbon efficient than the systems proposed for the Great Wolf development at the outset, when taking into account the decarbonisation of the electricity grid. Please refer to Appendix 3 for further detail on the relative merits of electrically led strategies compares to gas-fired systems as a result of the electricity grid decarbonisation.

It is therefore not proposed to connect to external district energy networks

Combined heat and power (CHP).

This section considers the relative merits of providing a stand-alone on-site heat network served by a dedicated energy centre with either Combined Heat and Power (CHP) or Combined Cooling Heat and Power (CCHP).

Due to the significant decarbonisation of the electricity grid over recent years, the implementation of a combined heat and power installation will achieve a worse result in terms of carbon reduction, when compared against other heat generating technologies, when the comparative heating systems are assessed using the SAP10 carbon emissions factors, which are known to be better aligned with reality.

CHP relies on the discrepancy between electricity and gas carbon emission factors to achieve carbon savings; a discrepancy which has now all but disappeared with the SAP10 carbon factors (see also Table 4)

Furthermore, CHP engines are not inherently efficient when compared against other heat generating technologies, are complex to run efficiently and maintain, and they emit elevated NOx emissions resulting in adverse air quality within the vicinity of their installation.

With reference to section 2.3 and the decarbonisation of the electricity grid, it is anticipated that CHP will no longer be an effective technology at reducing CO_2 emissions.

CHP is therefore not proposed.

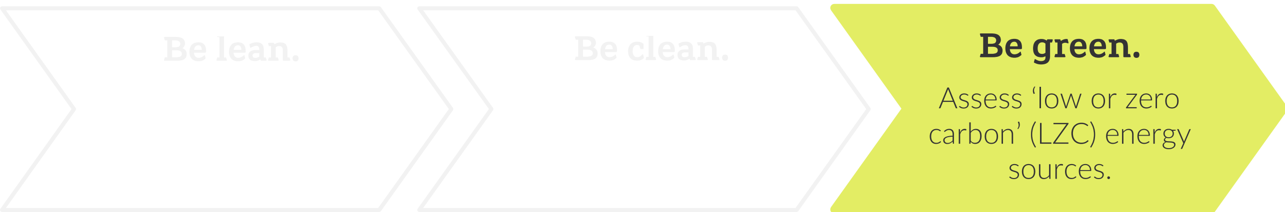
5.3 Be clean summary.

The proposed development is not located near to any district energy networks that are sited in a location that would make connection viable from a carbon reduction perspective.

With reference to section 2.3 and decarbonisation of the national grid, it is anticipated that CHP will no longer be an effective technology at reducing CO_2 emissions and therefore this is not considered an option for the Proposed Development.

6. Be green.

The final step of the energy hierarchy explores the feasibility of Low and Zero Carbon (LZC) technologies to allow for the production of renewable energy onsite in order to offer a further reduction in carbon emissions.



6.1 Low and zero carbon (LZC) technology assessment.

Renewable or zero carbon technologies harness energy from the environment and convert this to a useful form. Many renewable technologies are available, however, not all of these are commercially viable or suitable.

	Photovoltaics. Photovoltaic panels harness energy from daylight and convert this into useful energy in the form of electricity. A PV system requires viable roof space in order for the system array to be installed and function effectively. Suitability to proposed development: An initial appraisal of the available roof space at the proposed development has been undertaken. In discussion with the architect it is expected that 1,000m^2 of PV can be located on the south facing pitched roof of the waterpark, equivalent to an array with an approximate peak output of 150 kWp. This is an optimum location for PVs, and it is expected this array will result in carbon emission reductions of approx. 1% for the Proposed Development.
	Solar thermal. Solar Thermal Panels are similar to PV Panels in that they harness energy from solar irradiation. This technology however converts solar into thermal energy that can offset the demand on hot water generation systems. Suitability to proposed development: Inter-linking solar hot water systems with other proposed systems at the Proposed Development would add a layer of complexity to the design. Further, a solar thermal system would compete with the proposed PVs for the south-facing roof space. It has been preferred to incorporate PVs in the design due to the simplified interface with other systems. Solar thermal systems are therefore not proposed for the Development.
	Air source heat pump. Air Source Heat Pump (ASHP) and Ground Source Heat Pumps (GSHP) work to extract heat from the air or the ground. Generally, GSHPs are more efficient as the ground temperature is more stable over the course of the year relative to the air temperature, however overall output can be less. Suitability to proposed development: Currently the cost analysis to date has confirmed that a strategy led by water source and air source heat pumps is the most appropriate option for the Proposed Development, and this solution is expected to reduce carbon emissions considerably. For this reason, the technology has been included as the main heating and cooling source in the Proposed Development. Detailed descriptions have been given in the Be Lean section above.
	Wind turbine. Wind turbines would be likely to generate noise which may be a nuisance to neighbouring properties. Further. small wind turbines are known to provide only limited carbon reductions in reality, and this technology is best suited to large, stand-alone wind farm proposals. Suitability to proposed development: Considering the impacts described above and the visual impact of wind turbines on the character and appearance of the area, the use of wind turbines will not be proposed for the development.
	Biomass. Biomass boilers burn wood fuel or other bio-fuel sources to generate heat. These boilers can operate at high efficiencies, comparable to condensing gas boilers. However, they require a large fuel store to maintain continuous operation during the winter months. As such, area take for such plant is high. Furthermore, security of fuel supply is an important consideration. Suitability to proposed development: Biomass boilers can yield good regulated CO_2 emissions savings however this would also lead to in an increase of local NOx emissions from the site. This will reduce the local air quality. As such, the use of biomass boilers at the proposed development is considered to be unsuitable.

6.2 Be green summary.

Heat pump technologies are proposed as the primary heat generator for the proposed development. Within the family entertainment centre and hotel, a combination of Water Source Heat Pumps (WSHP) and Reversible Air Source Heat Pumps (RASHP) will be used. Within the waterpark Air Source Heat Pumps (ASHP) will provide a significant percentage of the annual waterpark heating load.

A detailed description of this strategy is set out in the Be Lean section above.

Further, a Photovoltaic Panel (PV) array of 1,000m^2 panel area (approx. 150kWp) is proposed for the Development.

Energy performance comparison – Part L methodology

The tables below outline the anticipated annual energy requirement split by utility (electricity and gas) for the holistic energy strategy compared to the Base Scheme, using the Part L methodology.

Table 6: Total estimated energy demand using the Part L methodology.

	Gas MWh/year	Electricity MWh/year	Total energy uses MWh/year
Base Scheme energy strategy	9,660	1,940	11,600
Proposed holistic energy strategy including waterpark ASHP and PVs	840	4,910	5,750

Carbon performance comparison – Part L methodology

The table below outlines the anticipated CO_2 emissions reductions associated with implementing the holistic energy strategy, compared to the Base Scheme when using the Part L calculation methodology, and comparing Part 2013 and SAP10 carbon factors.

Table 7: Carbon performance using Part L 2013 and SAP10 carbon content figures respectively.

	Part L 2013 Annual Carbon Emissions (tonnes)	% Improvement to Part L Notional Building using Part L 2013 Carbon Emissions	SAP10 Annual Carbon Emissions (tonnes)	% Improvement to Part L Notional Building using SAP10 Carbon Emission Factors
Part L Notional Building (i.e. Building Regulation Mandatory Requirement)	2,990	N/A	2,400	N/A
Base Scheme including PV array	2,930	2.0%	2,390	0.4%
Proposed holistic energy strategy including waterpark ASHP and PVs	2,640	12%	1,280	45%

Energy performance comparison – CIBSE TM54 methodology

The tables below outline the anticipated annual energy requirement split by utility (gas and electricity) for the holistic energy strategy compared to the Base Scheme, using the TM54 methodology.

Table 8: Total estimated energy demand using the CIBSE TM54 methodology.

	Gas MWh/year	Electricity MWh/year	Total energy uses MWh/year
Base Scheme energy strategy	11,770	7,410	19,180
Proposed holistic energy strategy including waterpark ASHP and PVs	880	10,170	11,050

Carbon performance comparison – CIBSE TM54 methodology

The table below outlines the anticipated CO_2 emissions reductions associated with implementing the holistic energy strategy, compared to the Base Scheme, when using the TM54 methodology, and comparing Part 2013 and SAP10 carbon factors.

Table 9: Carbon performance using Part L 2013 and SAP10 carbon content figures respectively.

	Annual Carbon Emissions using Part L 2013 Carbon Emission Factors (tonnes)	% Improvement to Base Scheme using Part L 2013 Carbon Emission Factors	Annual Carbon Emissions using SAP 10 Carbon Emission Factors (tonnes)	% Improvement to Base Scheme using SAP10 Carbon Emission Factors
Base Scheme including PV array	6,390	-	4,200	-
Proposed holistic energy strategy including waterpark ASHP and PVs	5,470	14%	2,560	39%

7. Energy Strategy Summary.

7.1.1 Energy and carbon reduction summary

The adoption of heating and cooling system strategy described in this report will result in a significant overall energy and carbon savings across the development, when compared to an equivalent 'base scheme'.

Base Scheme	The 'base scheme' represents a conventional heating and cooling strategy that would be typically be adopted to service this type of development, and includes: – A refrigerant based hybrid VRF system to heat and cool the hotel, with gas-fired water heaters utilised to generate domestic hot water. – Gas-fired boilers and air-cooled chillers to heat and cool the Family Entertainment Centre, with the gas- fired boilers also utilised to generate domestic hot water and temper fresh air supplied via mechanical ventilation systems. – Gas fired boilers for the waterpark to generate heating and hot water including pool water heating
Be Lean - Passive design and energy efficiency	This represents the strategy that will be implemented in the Proposed Development – Reasonable glazing ratio and glazing g-value to balance heat losses, heat gains and daylight. – Fabric insulation levels achieving improvements over the Building Regulations Part L (2013) requirements. – Fabric air permeability improvement upon Building Regulations Part L (2013) requirements by 70% – compared to the limiting values for all areas. – Mechanical ventilation with heat recovery with a low SFP which will limit the need for space heating in winter, aid the mitigation of overheating risk in summer, and maintain good indoor air quality. – Insulated pipework and ductwork (and air sealing to ductwork) to minimise losses and gains
Be Lean - Energy Demand Reduction	– Implementation of an innovative heating and cooling system which will capture heat that would typically be rejected to atmosphere by air-cooled chiller plant during the cooling season. The captured heat will instead be utilised to contribute towards the constant base heating load present throughout the year, in effect providing a proportion of 'free heat', thus reducing the energy demand of the Proposed Development.
Be clean	'Be clean' measures have been deemed unfeasible. Incorporation of an onsite district heating and a CHP system has been deemed to be unsuitable as it would offer no carbon benefit to the proposed development, therefore a heat network and /or CHP technology has been discounted.
Be green	Energy supply using low & zero carbon technologies – Highly efficient heating and cooling delivered through heat pumps, which are a low carbon technology, with boilers provided as top-up. – A 1,000m^2 PV panel array is proposed on the south facing, pitched roof of the waterpark

Results have been reported using two methodologies: Part L, in line with the requirements of the UK Building Regulations; and CIBSE TM54 which gives a better idea of the actual estimated energy consumption for the development as it allows for inclusion of unregulated energy uses (especially the pool water heating and laundry water heating are expected to be significant in the Proposed Development), and more flexibility in inputs used.

Carbon factors
Two separate sets of carbon emission factors are reported on: Part L 2013 (in line with current building regulations, but with known outdated carbon factors, especially for grid electricity), and SAP 10 (expected upcoming building regulations, as reported in draft Part L guidance, with more realistic factors).

7.2 CO_2 Emission reductions.

The adoption of the holistic energy strategy described in this note is expected to result in a carbon emissions reduction of 12% when using Part L 2013 carbon factors. However, when the more realistic SAP10 carbon emissions factors are utilised, carbon emission reductions of 45% are anticipated to be achievable. Please refer to figures 12&13 (overleaf).

For clarity, it is highlighted that the reported results show the expected carbon emission reductions when comparing the proposed holistic design with the 'base scheme' building as described in sections 3.5 & 3.6.

When the holistic energy strategy is modelled using Part L calculation methodology (i.e. heat pumps are implemented as described within this report), the calculation methodology assesses the building against a comparative building which also incorporates heat pump technology, known as the notional building'. The heat pumps within the notional model have pre-defined efficiency values (which are lower than the efficiency values of the heat pumps proposed for the proposed development).

The carbon reduction associated with the implementation of the holistic energy strategy will therefore appear lower than reality on the resulting BRUKL Output Document (i.e. Part L calculation output), as the holistic scheme will have been reviewed against a comparative heat pump scheme, as opposed to the actual base scheme (which incorporates gas-fired boilers in lieu of heat pumps). The resulting holistic energy strategy BRUKL Output Document is therefore currently expected to show a 7% reduction in carbon emissions, as opposed to 12% reduction as identified above.

Please refer to Appendix 1 for BRUKL documentation.

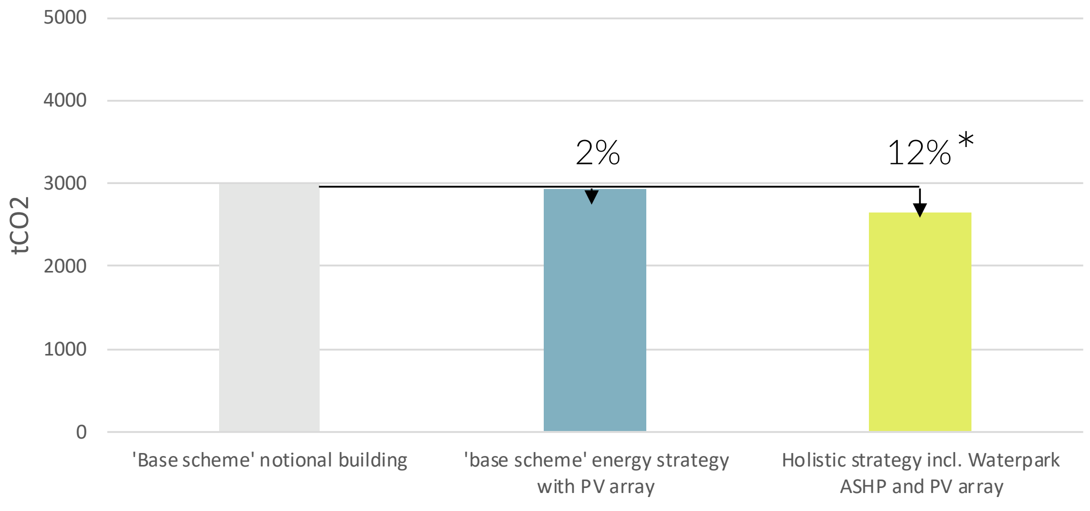


Figure 12: Part L modelling results using Part L 2013 carbon factors
*) Results are compared against a 'base scheme' which assumes a traditional energy strategy approach using boilers and chillers, and which is compliant with Part L 2013. Please refer to sections 2.2 & 7.2 for further detail.

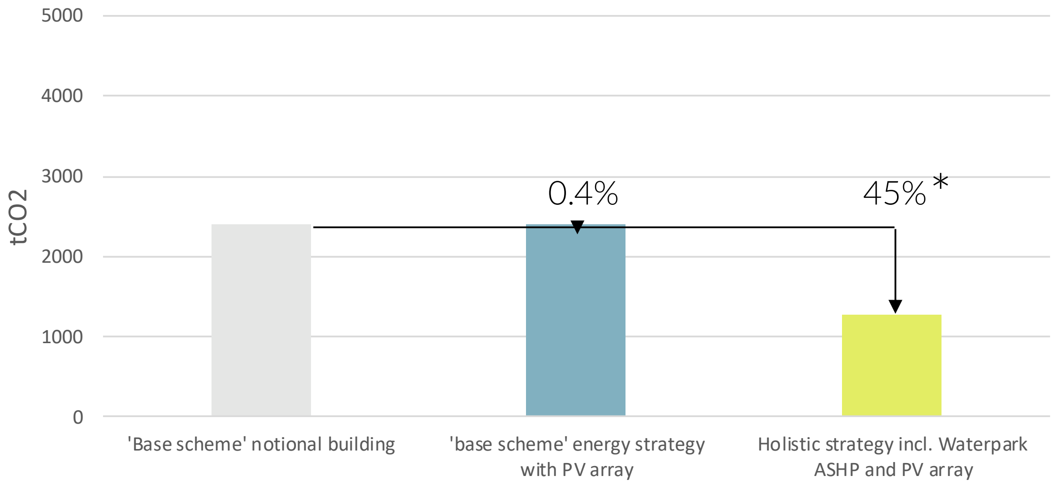


Figure 13: Part L modelling results using SAP 10 carbon factors
*) As above, results are compared against a 'base scheme'. Please refer to sections 2.2 & 7.2 for further detail.

Results of the CIBSE TM54 modelling exercise are given in the figures below. The holistic energy strategy is currently expected to achieve 39% carbon emission reductions compared to the 'base case' energy strategy systems, when using SAP 10 'current realistic' carbon emission factors. This is equivalent to approx. 1,640 tonnes of CO_2 per annum.

This is clearly a very significant carbon emission reduction for the development. This assessment is considered the most realistic assessment based on actual operational carbon reductions, as it is an estimate of the actual predicted operational energy consumption rather than assessment against Part L methodology, and is based on up-to-date carbon factors.

In addition, as the electricity grid continues to decarbonise, the electrically-led holistic heating and cooling system proposed for the Proposed Development will result in even lower carbon emissions going forward. Some further thoughts on this are given in section 8 below.

TM54 calculations using Part L 2013 carbon factors are expected to result in carbon emission reductions of approximately 14%, equivalent to 920 tonnes of CO_2 per annum.

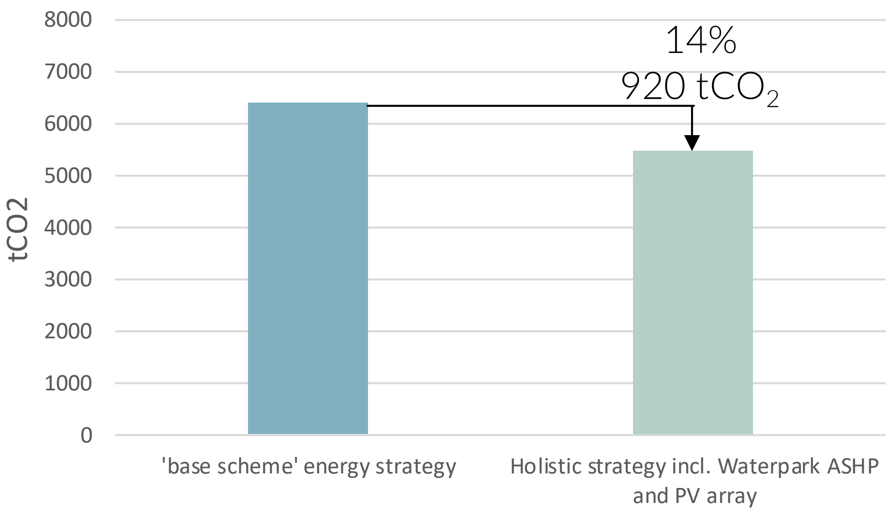


Figure 14: CIBSE TM54 (operational energy performance evaluation) modelling results using Part L 2013 carbon factors

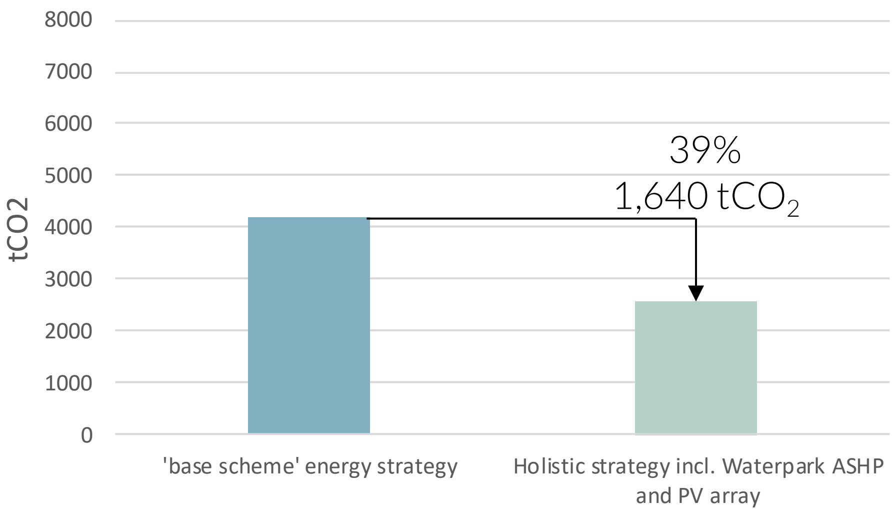


Figure 15: CIBSE TM54 (operational energy performance evaluation) modelling results using Part L 2013 carbon factors

8. Future gazing.

As has been described in this energy strategy, it is anticipated that the carbon factor for grid electricity will continue to fall in the years to come. Figure 16 below shows an assessment of the progression of the carbon emissions for the Proposed Development year on year, based on the National Grid's *Future Energy Scenarios 2018* information, and using the 'consumer evolution' scenario, which is one of the 'middling' scenarios (i.e. not the most optimistic projection, but not the most pessimistic either).

This shows that the holistic energy strategy may be expected to emit 51% less carbon per annum in 2050 compared to the present day, whereas the base case scheme would only be able to achieve reductions of 19%. This further bolsters the argument for implementing an electricity-led strategy for the Proposed Development, such as the one proposed in this energy strategy.

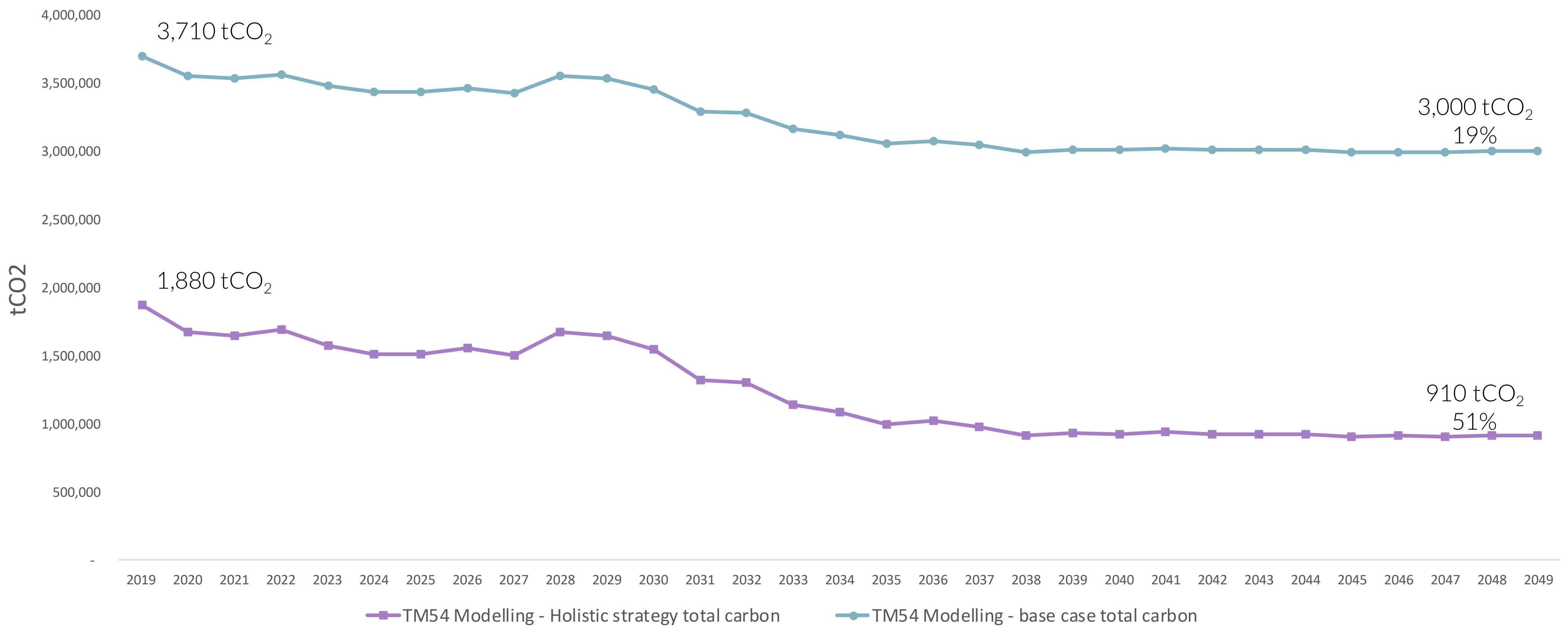


Figure 16: Estimated progression of the carbon emissions for the Proposed Development year on year, Part L results compared to TM54 results, using information given in the National Grid's Future Energy Scenarios 2018

9. Sustainability Strategy.

9.1 Land and Building.

The Proposed Development will be designed and built to a high standard that is compatible, in scale and in character of surrounding development and its setting.

The Proposed Development has been designed to include the following:

- Responsible sourcing of materials.
- Provision of sufficient waste and recycling facilities to facilitate the segregation of waste streams.

9.2 Passive Design and Energy Efficiency.

Passive design measures that will be implemented at the Proposed Development:

- Suitable glazing specification to balance heat losses, heat gains and daylight ingress.
- Fabric insulation and airtightness levels targeting significant improvements over the Building Regulations Part L2A standards.

Energy Efficiency measures which will be implemented at the Proposed Development:

- Energy load sharing through the adoption of a holistic energy strategy incorporating water source and air source heat pumps
- Modern building services including high efficiency ventilation plant with variable speed fans and high levels of heat recovery.
- Efficient low-energy lighting throughout all spaces with low heat output to minimise risk of high internal heat gains.

9.3 Climate Change Adaption.

The design will contribute to adaptation and mitigation of the effects of climate change by the specification of high performing elements to minimise heat gains and losses.

The Proposed Development will improve upon the requisite standards of Part L 2013 of the Building Regulations.

The Proposed Development will be designed in accordance with the cooling hierarchy to minimise cooling demand. Mitigation measures such as an appropriate glazing ratios and g-values, high levels of insulation and minimisation of internal heat gains are targeted. Through these measures, the relevant areas of Proposed Development will achieve compliance with Criterion Three of the Building Regulations Part L (2013).

Other climate change adaptation measures which will be implemented for the development include the provision of green roofs to contribute to the biodiversity of the site, to minimise the buildings contribution to the urban heat island effect, and to provide a sustainable urban drainage system measure.

Figure 17 Sustainability measures implemented in the scheme.

9.4 Conservation of Energy, Water, Materials and Other Resources.

Energy and carbon emission reductions

The Proposed Development is targeting significant energy and carbon emission reductions compared to a 'base scheme' which incorporates conventional systems for this type of development, and which is compliant with Part L (2013) of the Building Regulations.

It is anticipated that this target for CO_2 emissions reductions will be achieved from a combination of passive design, energy efficiency, load sharing, and renewable technologies as described in the energy strategy sections above.

Water consumption reduction

The developer, an established water park operator and who has knowledge and expertise in water efficient technologies, will invest in the adoption of regenerative media filter technology (i.e. 'Defender' filters) in lieu of industry standard 'deep bed medium rate sand filters', in order to considerably reduce the amount of water required for the backwash process, saving an estimated 28,800,000 litres potable water per annum.

The Development will be fitted with water efficient fixtures and fittings, and water meters will be provided to enable the monitoring of water consumption.

The Development is targeting potable water reduction equivalent to a 40% reduction compared to the BREEAM 2018 'baseline' for credit Wat 01.

Mains water metering will be incorporated in the design, as well as sub-meters to water-consuming plant or building areas consuming 10% or more of the building's total water demand. Meters will be connected to the central Building Management System.

A leak detection system capable of detecting a major water leak will be installed on the utilities water supply to detect any major leaks within the building, as well as between the buildings and the utilities water supply.

The current surface water drainage scheme includes permeable sub-bases, swales, storage ponds and attenuation tanks to control the stormwater run-off from the site. It is proposed that water will be pumped from the main below ground surface water attenuation tank to serve toilet/WC cisterns in hotel rooms via a day tank and appropriate water filtration and treatment equipment.

It has been estimated that the provision of the described surface water attenuation system could reduce annual water consumption in the hotel alone by circa 13,860,000 litres per annum.

Irrigation

The parkland style to the landscape integrated around much of the site will comprise native trees, woodland, grassland and wildflower meadow that will not require watering once established, as these species will be selected to ensure they are tolerant of natural seasonal conditions. Ornamental planting will be used sparingly but will also largely comprise of native species, along with species tolerant of varying UK weather conditions, to minimise the requirement for watering following establishment.

Occasional watering would be required during the first 5 years of establishment to all areas of new planting, which will be provided by bowser, fed from existing waterbodies in the wider parkland. It is anticipated that no mains cold water will be required for irrigation purposes across the site.

Please refer to the Outline Water Resources Scoping Note prepared by Hoare Lea for further information.

Materials

The use of construction products leads to a wide range of environmental and social impacts across the life cycle through initial procurement, wastage, maintenance and replacement. Taken together, construction products make a highly significant contribution to the overall life cycle impacts of a building. In some cases they may even outweigh operational impacts (such as energy consumption).

An assessment of the lifecycle impact of the development materials has been undertaken, comparing options for a number of key building elements.

Building elements will be selected to minimise environmental impact. A full review of the materials specified for the development will be undertaken during the detailed design development stages aiming for materials to meet the following requirements where possible:

- Responsible sourcing certificates
- Environmental Product Declarations
- Low emitting materials

Insulation will be specified to have a Green Guide Rating of A where possible, and minimise Global Warming Potential (GWP), and all timber used at the Proposed Development aims to be FSC or PFC certified or similar.

Figure 18 Examples of responsible sourcing schemes.

9.5 Construction.

The Proposed Development will be constructed by a developer certified under the Considerate Constructors Scheme who will be expected to target good practice score in all sections. The contractor will furthermore monitor and set targets for, and monitor, energy usage, water usage and construction waste related to the site for the duration of the works.

During the construction phase, all areas of concern will be managed, including waste reduction strategies, noise and dust pollution, construction traffic and protection of any and all ecology features identified on the site. A construction management plan will be created to assess the impact of construction activities and to identify methods of mitigation against any identified potential impact.

Work is to be scheduled within normal working hours where feasible.

Wheel washing, road cleansing and dust and noise suppression will be considered to ensure no adverse impact to the surrounding environment.

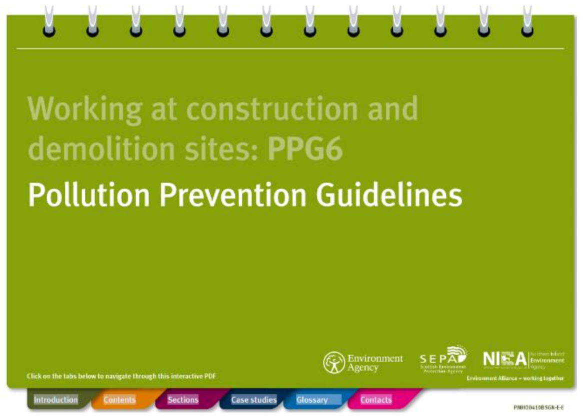


Figure 19 examples of considerate construction measures.

9.6 Transport Strategy.

Pedestrians and Cyclists.

Pedestrian and cycle access to the site will be taken from the A4095 via the main site access.

As part of the development proposals a new footway will be provided along the southern side of the A4095 from the site to Chesterton and will connect with the existing footway provision at the junction between the A4095 and The Hale. In addition, the proposed footway will continue west along the frontage of the site and extend as far as the existing public right of way path.

Secure cycle storage will be provided at the Development to maximise the potential for sustainable transport to and from the building for day guests and staff. In total, 80 cycle spaces, of which 40 will be allocated as 'short stay' (for day guests), and 40 will be 'long stay' (for staff).

Shuttle bus service

It is further proposed to provide a shuttle bus service between the resort and Bicester. The shuttle bus service will be available for guests and staff to use, free of charge. It is also intended that the shuttle bus will be available to residents of Chesterton, also free of charge.

For guests to the resort the shuttle bus service will connect the resort with local trains stations; both Bicester Village and Bicester North. In addition to the proposed guest shuttle bus service, it is proposed to provide a separate shuttle bus service for staff at the resort and it is intended that this service will also be available to residents of Chesterton. It is envisaged that the staff shuttle bus service will likely call at local stations, the town centre and local centres around Bicester.

Car parking

It is proposed that a total of 902 car parking spaces will be provided on site for use by guests and staff. A total of 56 disabled accessible parking bays will be provided on site, equating to 6% of total parking provision. The proposed disabled accessible parking provision exceeds the requirements of Traffic Advisory Leaflet 5/95 and accords with good practice guidance in BS8300.

Charging facilities for electric vehicles will be provided for 10% of the total number of car parking spaces (90 spaces total).

Travel Plan

A Framework Travel Plan has been produced for the Proposed Development, setting out a long-term strategy to inform staff and visitors of the travel choices available to them and to encourage sustainable modes of travel, in particular public transport, walking and cycling.

Please refer to the Transport Assessment and Framework Travel Plan, prepared by Motion, for further details.

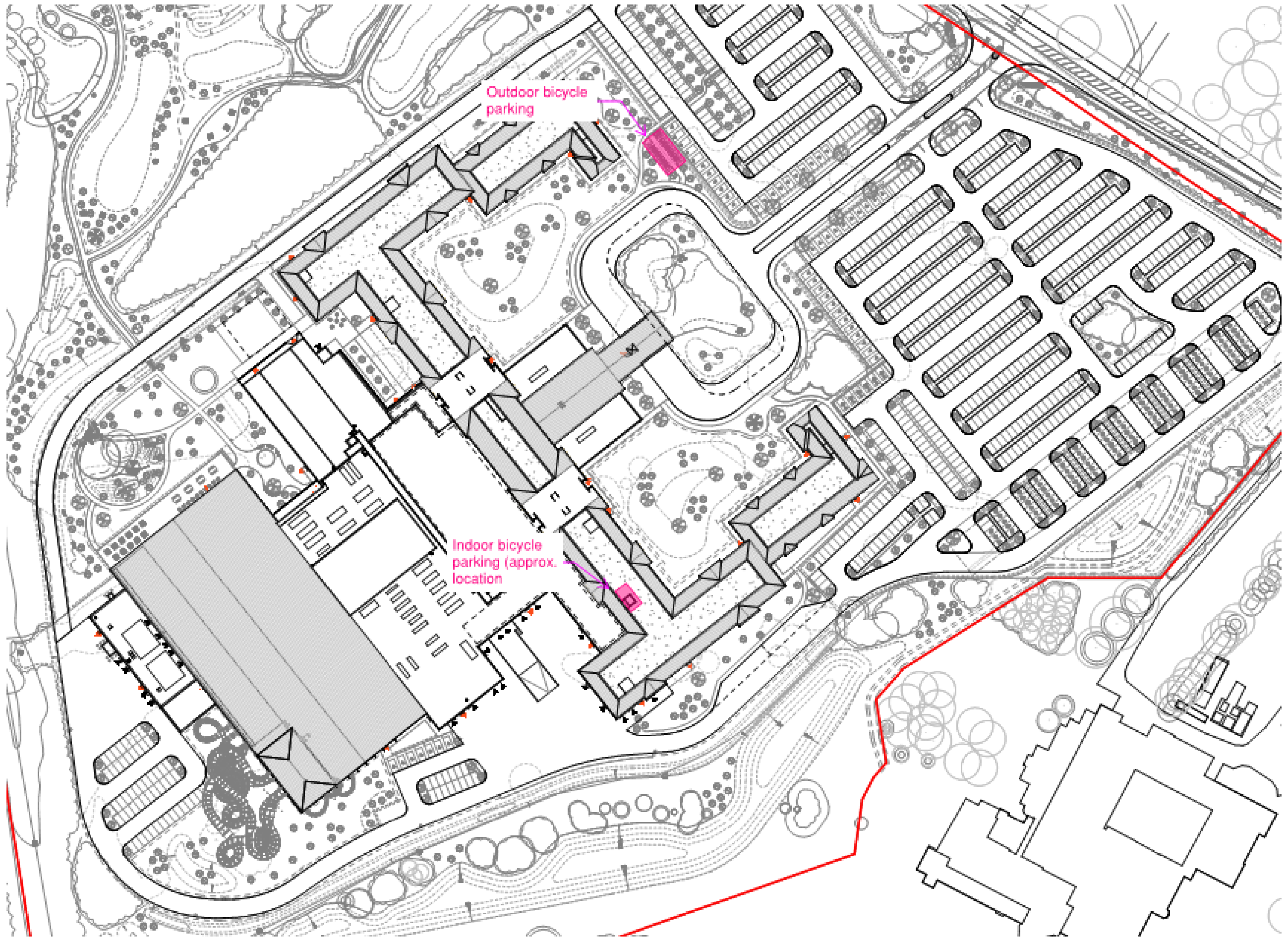


Figure 20: Cycle storage plan drawing. Source: EPR

9.7 Refuse and Recycling.

Construction Site Waste Management.
The Principal Contractor, once appointed, will develop a Resource Management Plan (RMP) for the Proposed Development, to outline opportunities to steer the direction of waste management and ensure good practice is adopted for the construction phase of the Proposed Development.

The Principal Contractor will be required to adopt the recommendation measures made in line with the waste hierarchy with the aim of maximising diversion from landfill. The Proposed Development will be constructed in a manner which aims to protect the environment and local community through reusing, recycling and recovering waste which would otherwise be disposed of at landfill.

Operational Waste.
The Proposed Development will include three main waste stores; a store for food waste, a store for recyclable waste and an area for a compactor for refuse.

Operational waste will be segregated into glass bottles, cardboard & paper, and Dry Mixed Recycling (DMR), which would comprise items such as plastic bottles, plastic packaging, and metal cans. A glass crusher will also be provided in the waste store to reduce the volume of glass for collection. Waste stores will be clearly labelled to ensure cross contamination of all waste streams is minimised. All waste storage areas will be built to BS 5906:2005 standards.

Proposed locations where the Refuse Collection Vehicles would park when emptying bins have been designed so that collection operatives will not be required to transport the bins a greater distance than 10 metres.

Please refer to the Waste Management Strategy for further information.

Figure 21 Waste Hierarchy.

9.8 Heath & Wellbeing.

Indoor Air Quality.
The quality of the air within buildings can have a considerable effect on health due to the amount of time people spend indoors. The Proposed Development will consider developing and implementing an indoor air quality plan which aims to highlight potential sources of pollution and minimise spread or contamination; an enhanced fresh air delivery rate compared to minimum standards will be provided; completion of a post completion building flush out, to help remove any harmful substances with in the indoor environment, prior to tenant occupation. Additionally, all finishes installed in the building will aim to have low volatile organic compound (VOC) content.

Figure 22 Example LOW VOC paint.

Daylight & Thermal Comfort.
The Proposed Development has optimised the glazing ratios and g-values in order to maximise exposure to daylight, whilst considering the level of incoming solar gains in order to minimise the energy consumption necessary for cooling.

Noise.
Any negative effect to the acoustic environment nearby as a result of the Proposed Development will be mitigated as far as practically possible.

An acoustic consultant has been appointed to provide expert advice to the development with regard to internal acoustic conditions (with bedrooms being the most noise sensitive areas), and risk of noise ingress to sensitive receptors from the Proposed Development.

The external fabric of the hotel (including walls, windows and roof) shall be designed and constructed such that the resultant in-situ internal noise levels, due to external noise intrusion, shall not exceed criteria set by the acoustic consultant.

Building services plant atmospheric noise emission shall be engineered to ensure the acoustic requirements to all hotel areas are maintained. They shall be controlled so as not to cause a nuisance to neighbouring properties or to public areas external to the hotel, such as restaurant terrace, and the main entrance. It should be assumed that all plant will operate twenty-four hours per day.

9.9 Landscaping & Biodiversity.

Ecology & biodiversity
Extensive work has been carried out with regards safeguarding and improving ecology and biodiversity on site.

The majority of the Site is currently of low biodiversity value, comprising approximately 67% amenity grassland The Proposed Development aims to enhance the majority of the existing amenity grassland to semi-improved neutral grassland. The remaining areas of site will comprise the hotel complex and associated hardstanding and landscape planting. Existing waterbodies, woodland and hedgerows will be retained and enhanced where possible.

No irreplaceable habitat or statutory designated sites are directly impacted by the Proposed Development. Under current landscape plans, the Proposed Development would result in an overall net gain (+31%) in area-based biodiversity units, with no area-based HPI habitat lost. There would be a net gain of linear units generated by hedgerow HPI (+316%) and running water (+14%).

Although there is a net loss in three woodland habitat types (broadleaved parkland/scattered trees, coniferous parkland/scattered trees and Mixed parkland/scattered trees), the Proposed Development has achieved net gain for similar habitat types: mixed plantation woodland and broadleaved plantation woodland. Consequently, the Proposed Development does achieve an overall biodiversity net gain.

The ecologist and the landscaping designers have worked closely to incorporate all recommendations into the design, such as bird and bat boxes, specific species of plants, wildlife gaps to the perimeter of the site etc.

Elements of the existing / retained and proposed landscape will be managed as part of a coordinated maintenance strategy to ensure its successful establishment and long-term sustainability and a Landscape Management & Maintenance Plan is included as part of this planning application.

Please refer to the Ecological / Biodiversity Assessment prepared by WSP and the Landscape Management & Maintenance Plan prepared by Bradley Murphy Design for further information.

Green Roof
The Proposed Development will further enhance local ecology and biodiversity thorough the inclusion of a green roof, as shown in Figure 23 below. Additional sustainable drainage (SUDS) benefits are also provided by the inclusion of a green roof system.

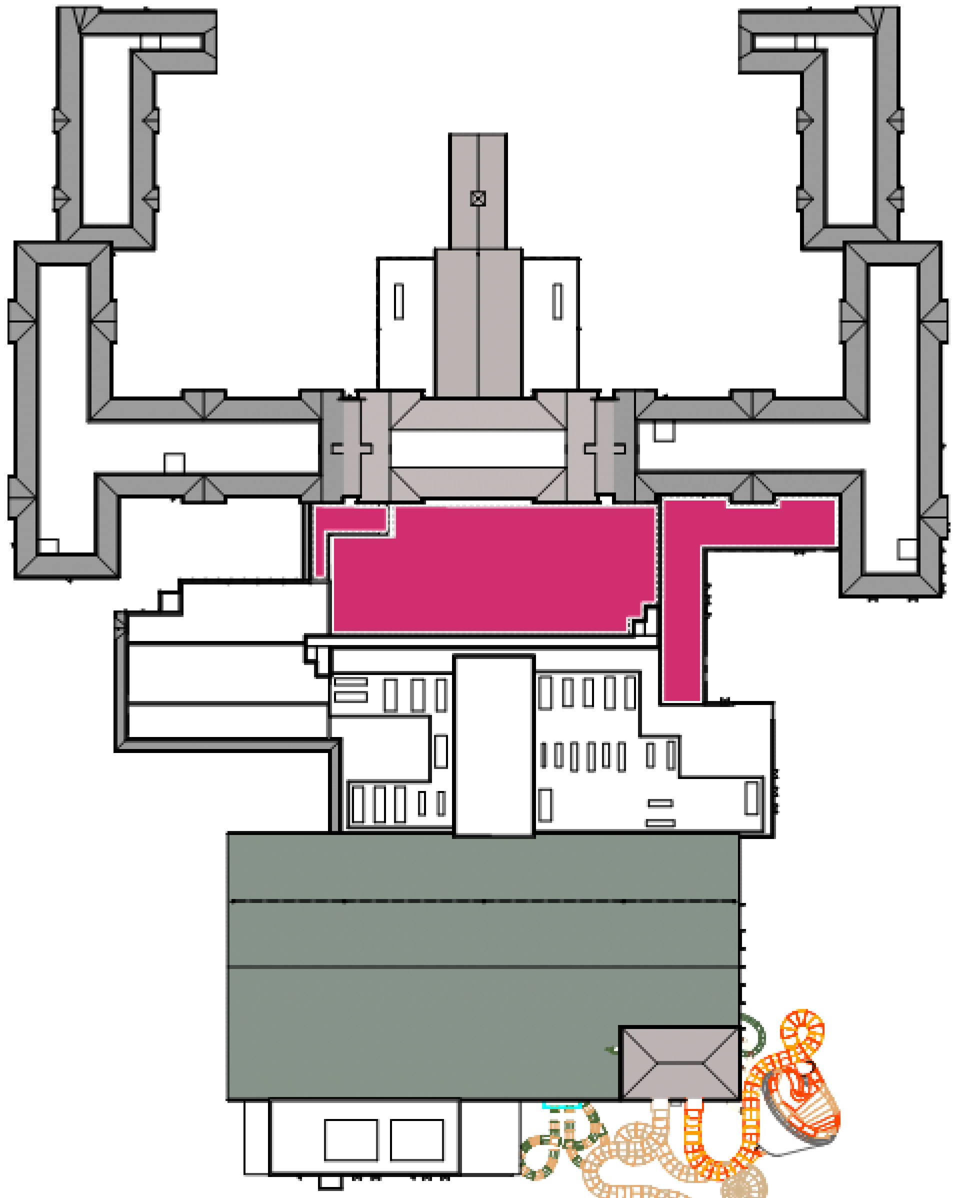


Figure 23: Green roof allocation shown in pink colour on three roof areas at the centre of the Proposed Development. Source: EPR Architects (with Hoare Lea mark-up for clarity)

Hard Landscaping
High quality paving and walling materials will be used across the scheme.

It is the hard landscape that creates the general layout of the front area of the scheme and differing materials will be used to define the various paths and ramp, and be used to visually link the whole frontage together.

In order to integrate the development into the surroundings, materials that are characteristic of the area will be chosen. Generally a simple palette of one or two types of material will be used in order to provide a uniform effect. The type and quantity of outdoor furniture has been designed to avoid clutter, while providing a safe, convenient and attractive environment to use.

9.10 Pollution Prevention.

During Construction.

During the construction phase, all areas of concern will be managed including waste reduction strategies, noise and dust pollution, and construction traffic.

Contractors will be required to identify potential sources of dust and other air pollution and appropriate dust control measures would be implemented.

It is also intended that the main contractor shall register under the Considerate Constructors Scheme and achieve a best practice score. The contractor will furthermore monitor and set targets for energy usage, water usage and construction waste related to the site for the duration of the works.

Air Quality.

The fabric of the building will be improved to be very air tight, targeting a permeability of $3m^3/(m^2.h)$ at 50Pa. As such, air pollution would not be permitted to enter the building through the fabric, whilst the mechanical ventilation system will also filter out unwanted pollutants to provide a high standard of indoor air quality.

External Lighting.

The development will follow Secured by Design Principles where feasible to ensure that a safe and secure environment is provided.

All external lighting will be energy efficient, and it is anticipated that suitable controls such as daylight detection and time-switches will be installed to minimise inappropriate use. Luminaires will be provided with suitable outputs and polar curves in order to direct lighting appropriately to further reduce light pollution and loss of light to the sky in order to minimise adverse effects to neighbouring buildings or biodiversity.

9.11 Building Research Establishment Environmental Assessment Method - BREEAM

In order to demonstrate the sustainability credentials of the building, the Proposed Development is undertaking certification with the Building Research Establishment Environmental Assessment Method, and is targeting a rating of Very Good under the BREEAM New Construction 2018 scheme.

A pre-assessment for the project has been carried out and a summary is provided in Appendix 2. In order to achieve a Very Good rating a score of 55% is required, as well as all related mandatory credits achieved.

The current pre-assessment predicts a baseline score of 60.9% i.e. a margin above the required minim score for 'Very Good' of 5.9%.

A number of additional potential credits has been identified and will be explored during detailed design in order to safeguard the targeted rating against any future design changes or unforeseen site constraints

Appendix 1A: Part L2A 2013 – BRUKL summary – Base Case model

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Great Wolf — As designed

Date: Thu Oct 10 11:40:42 2019

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.11

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.11

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	60.7
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	60.7
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	59.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	000000EC:Surf[2]
Floor	0.25	0.18	0.18	000000DD:Surf[0]
Roof	0.25	0.18	0.18	000002FA:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.6	1.6	000000EC:Surf[1]
Personnel doors	2.2	2.2	2.2	000002E4:Surf[0]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

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Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	50500.6	50500.6
External area [m²]	73643.1	73643.1
Weather	BIR	BIR
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	16706.1	23806.3
Average U-value [W/m²K]	0.23	0.32
Alpha value* [%]	10.08	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
100	**C1 Hotels**
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	20.77	28.27
Cooling	1.79	2.41
Auxiliary	14.67	11.86
Lighting	16.18	16.25
Hot water	178.73	170.9
Equipment*	39.36	39.36
TOTAL**	**232.15**	**229.68**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	2.63	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	149.23	168.41
Primary energy* [kWh/m²]	361.12	371.67
Total emissions [kg/m²]	59.5	60.7

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

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Appendix 1B: Part L2A 2013 – BRUKL summary – Holistic model

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Great Wolf — As designed

Date: Thu Oct 10 13:43:14 2019

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.11

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.11

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

As noted in sections 2.2 and 7.2, the holistic energy strategy BRUKL Output Document is currently expected to show a 7% reduction in carbon emissions, as opposed to the 12% reduction which is expected when compared to the 'base case'

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	56.8
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	56.8
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	52.7
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	000000EC:Surf[2]
Floor	0.25	0.18	0.18	000000DD:Surf[0]
Roof	0.25	0.18	0.18	000002FA:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.6	1.6	000000EC:Surf[1]
Personnel doors	2.2	2.2	2.2	000002E4:Surf[0]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	50500.6	50500.6
External area [m²]	73643.1	73643.1
Weather	BIR	BIR
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	16706.1	23806.3
Average U-value [W/m²K]	0.23	0.32
Alpha value* [%]	10.08	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
100	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	9.95	12.72
Cooling	1	3.48
Auxiliary	33.07	25.5
Lighting	16.18	16.25
Hot water	56.28	65.53
Equipment*	39.36	39.36
TOTAL**	**116.48**	**123.47**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	2.63	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	126.57	148.71
Primary energy* [kWh/m²]	487.76	533.93
Total emissions [kg/m²]	52.7	56.8

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

Appendix 2: BREEAM Pre-assessment

A pre-assessment under the BREEAM 2014 Refurbishment and fit-out (RFO) scheme has been conducted for The Proposed Development.

The development is currently assessed using a 'hotel' assessment type. In line with local policy requirements, the assessment will be targeting a BREEAM 'Very Good' rating as a minimum.

The current anticipated baseline score is 60.9% which is 5.9% above the threshold for a 'Very Good' rating. A number of additional credits have been identified as 'potential' for the development to safeguard the target rating against future design changes and unforeseen site constraints – see table overleaf.

Figure 24 below summarises the current anticipated score and the maximum potential score relative to the minimum required score for each BREEAM rating threshold.

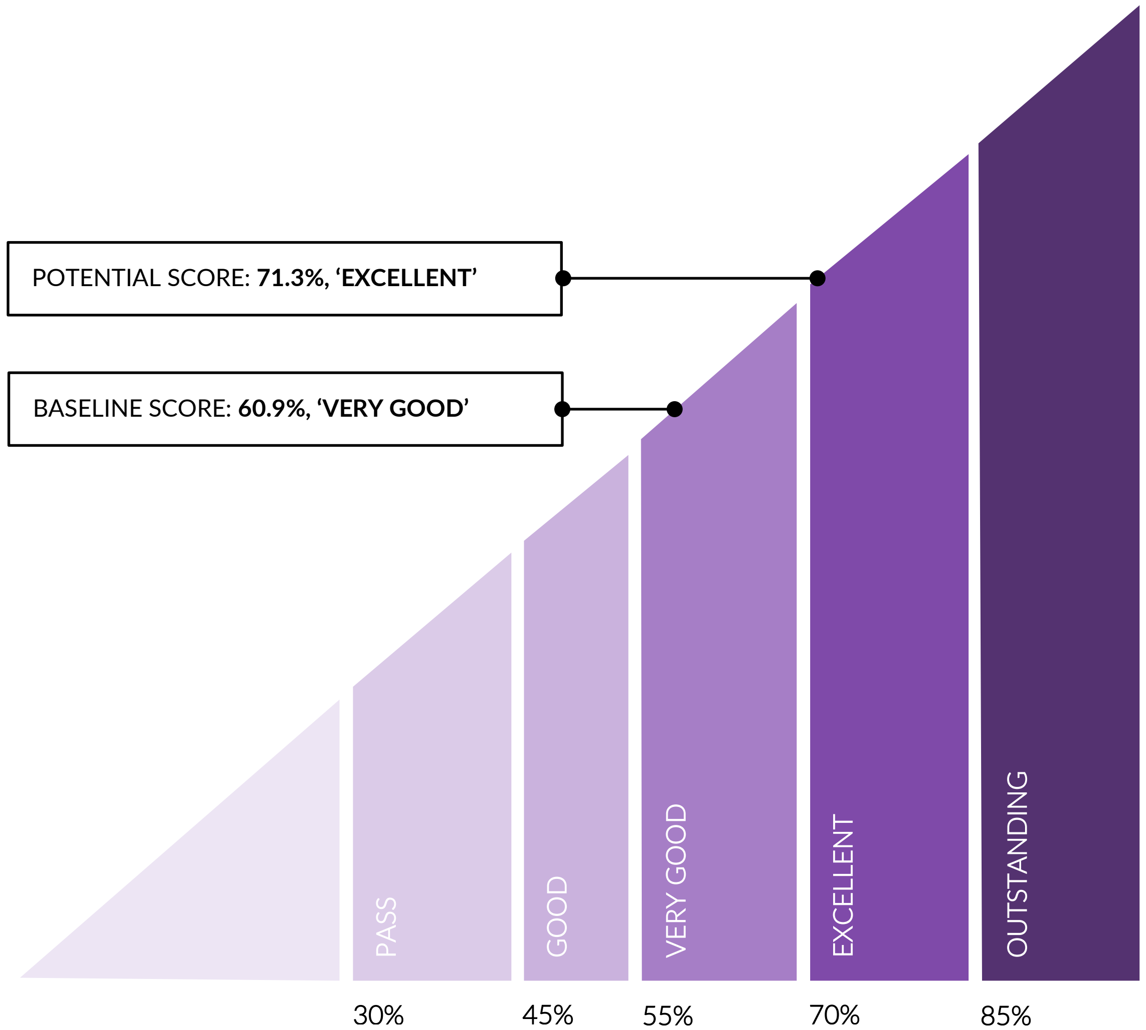


Figure 24: BREEAM 2018 Scale and Anticipated Performance Scores.

Table 10: BREEAM Target Summary.

Category	Issue	Credits		
		Available	Targeted	Potential
Management	Man 01: Project brief and design	4	2	-
	Man 02: Lifecycle cost and service life planning	4	1	+1
	Man 03: Responsible construction practices (M_e), (M_o)	6	6	-
	Man 04: Commissioning and handover (M_e), (M_o)	4	4	-
	Man 05: Aftercare (M_e), (M_o)	3	2	+1
Health & Wellbeing	Hea 01: Visual comfort	4	2	-
	Hea 02: Indoor air quality	4	0	-
	Hea 04: Thermal comfort	3	0	+2
	Hea 05: Acoustic performance	4	3	-
	Hea 06: Security	1	1	-
	Hea 07 Safe and healthy surroundings	2	2	-
Energy	Ene 01: Reduction of energy use and carbon emissions (M_e) (M_o)	13	6	-
	Ene 02: Energy monitoring (M) (M_e) (M_o)	2	2	-
	Ene 03: External lighting	1	1	-
	Ene 04: Low carbon design	3	0	-
	Ene 05: Energy efficient cold storage	N/A	N/A	N/A
	Ene 06: Energy efficient transportation systems	2	2	-
	Ene 07 Energy efficient laboratory systems	N/A	N/A	N/A
	Ene 08: Energy efficient equipment	2	0	-
Transport	Tra 01: Transport assessment and travel plan	2	2	-
	Tra 02: Sustainable transport measures	10	10	-
Water	Wat 01: Water consumption (M_v) (M_e) (M_o)	5	1	-
	Wat 02: Water monitoring (M_v) (M_e) (M_o)	1	1	-
	Wat 03: Water leak detection	2	1	-
	Wat 04: Water efficient equipment	1	1	-
Materials	Mat 01: Environmental impacts from construction products - Building life cycle assessment	7	4	-
	Mat 02: Environmental impacts from construction products - Environmental Product Declarations (EPD)	1	0	+1
	Mat 03: Responsible sourcing of construction products (M_v) (M_e) (M_o)	4	2	-
	Mat 05: Designing for durability and resilience	1	1	-
	Mat 06: Material efficiency	1	1	-
Waste	Wst 01: Construction waste management (M_o)	4	3	-
	Wst 02: Use of recycled and sustainably sourced aggregates	1	0	+1
	Wst 03: Operational waste (M_e), (M_o)	1	1	-
	Wst 04 Speculative finishes	N/A	N/A	N/A
	Wst 05: Adaptation to climate change	1	0	-
	Wst 06: Design for disassembly and adaptability	2	0	-
Land Use and Ecology	LE 01: Site Selection	2	0	-
	LE 02: Identifying and understanding the risks and opportunities for the project	2	2	-
	LE 03: Managing negative impacts on ecology	3	3	-
	LE 04: Change and enhancement of ecological value	4	2	
	LE 05: Long term ecology management and maintenance	2	2	-
Pollution	Pol 01: Impact of refrigerants	3	1	-
	Pol 02: Local air quality	2	0	+2
	Pol 03: Flood and surface water management	5	2	+1
	Pol 04: Reduction of night time light pollution	1	1	-
	Pol 05: Reduction of noise pollution	1	1	-
Innovation	Inn 01: Approved innovation and exemplary level credits	-	1 (Man 03)	+4 (Hea 06, Ene 01 (2), LE 02)
	Targeted weighted score & rating	60.9% 'Very Good'		
	Maximum potential weighted score & rating	71.3% 'Excellent'		

Appendix 3: Grid Decarbonisation.

Historic progress

The carbon factor of the National Grid – the amount of carbon dioxide released per kilowatt hour of electricity produced and distributed – is recognised in current Building Regulations as being 0.519 kgCO_2/kWh. However, the national mix of electricity generation methods is progressing towards greener solutions with renewable sources accounting for ever-increasing proportions of the energy mix.

As a consequence, the Building Regulations Part L 2013 value of the National Grid carbon factor has been shown to be substantially higher than how the grid is performing in reality. This severely impacts the calculated emissions produced by all heat raising plant which use electricity directly or generate it to offset other emissions. The figure below shows how the mix of generation techniques serving the National Grid, as well as the associated carbon factor, has varied over recent years. Encouragingly, the carbon intensity of the grid has reduced to less than half its value in 2012 [HM Government, "Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal", 02 January 2018].

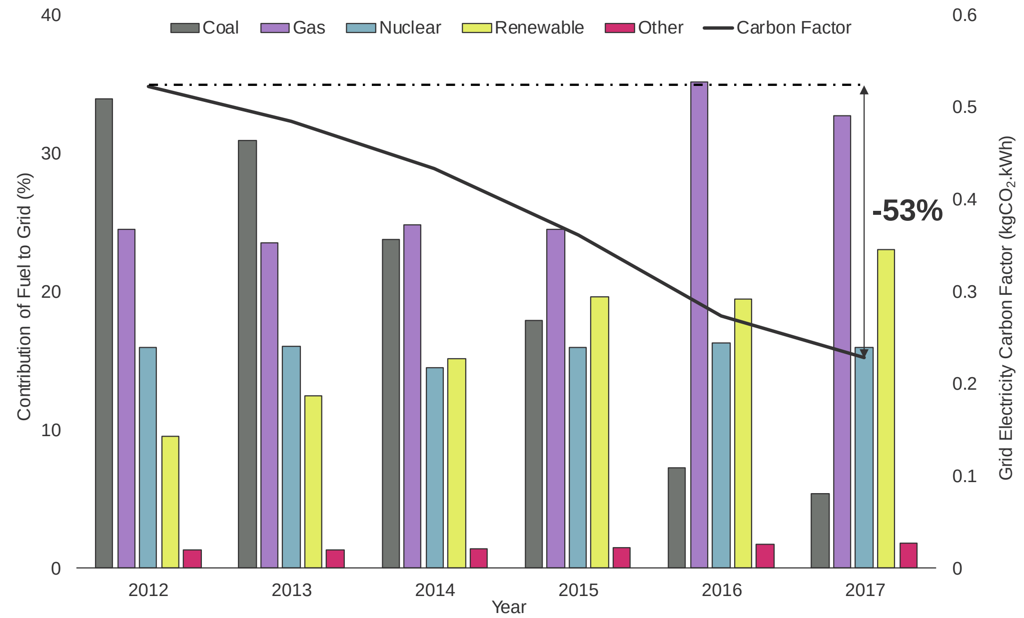


Figure 25: Historic mix of generation methods and associated carbon factor for the National Grid. 8% transmission and distribution losses are included. Sources: *electricityinfo.org* (generation mix); *BEIS Green Book* (historic carbon factors).

Future projections

The Future Energy Scenarios (FES) document, produced by the National Grid, discusses how the UK's energy landscape is changing. In this year's report, FES 2019, the carbon factor of the National Grid is projected to be greatly reduced by the end of this year, meaning the actual carbon emissions associated with electricity consumption are much lower than reported in Building Regulations. This means that, under the Part L 2013 methodology the CO_2 emissions associated with electrically-driven plant are being overestimated by over 200%. FES 2019 makes projections of how the mix of generation in the grid is likely to change between now and 2050 – the year by which the Climate Change Act 2008 set the target of reducing the UK's CO_2 emissions by 80% from 1990 levels.

FES discusses these projections in four scenarios with the best and worst-case scenarios (from an emissions perspective) being Two Degrees and Steady State respectively. Two Degrees describes a situation where a combination of drastic policy intervention and innovation pushes an ambitious agenda with a focus on long-term environmental goals – it is described as the 'cost optimal pathway to meet the UK's 2050 carbon emissions reduction target'. In contrast, Steady State is a 'business as usual' situation, where society is focussed on the short term and ensuring the security of the UK's energy supply.

The figure below combines these future trajectories with the actual carbon intensity of the National Grid over the past years. The reported emissions associated with electricity generation have fallen steeply since 2012 and in all cases, the FES 2019 scenarios see the carbon factor of electricity fall below 100gCO_2/kWh by 2035.

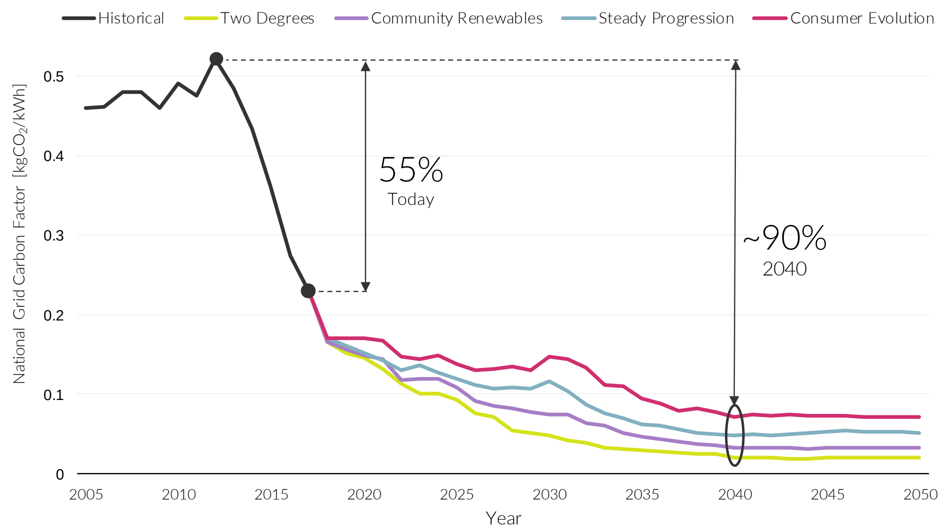


Figure 26: Historic and future projected carbon factor for the National Grid. 8% transmission and distribution losses are included. Sources: BEIS Green Book (historic carbon factors); National Grid Future Energy Scenarios (FES) 2018 (future projected carbon factors).

Consequences for servicing

The carbon emissions associated with the combustion of natural gas are unlikely to change significantly in the coming years, whereas the carbon factor of grid electricity, and consequently the emissions from operating electrical plant, is projected to decrease in all scenarios in the long-term.

As noted however, misrepresentative building regulations mean that even today, electrical plant performs far better from an emissions perspective than calculated using the Part L 2013 methodology. The following graph shows the net annual emissions of four different servicing strategies for a recent large scale, mixed use development. Whilst different in scope and scale to the Proposed Development, the impact incorrect carbon factors have on the calculated emissions is clear. For these reasons, an electrical servicing strategy is beneficial both today, and in the future.

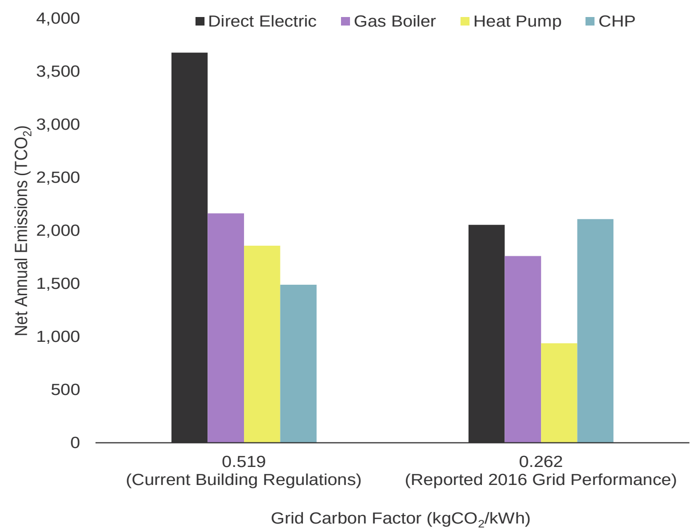


Figure 27: Net annual emissions for a large scale mixed use development for four different heating strategies using the current Building Regulations Part L 2013 grid carbon factor and the reported performance of the grid in 2016. Source: Future Energy Scenarios 2017.

Shifting focus

As the carbon emissions associated with the generation of electricity continue to reduce, the proportion of the UK's overall greenhouse gas emissions for which the electricity sector is responsible will fall.

The carbon factor of natural gas is likely to remain relatively static. With 85% of homes in the UK relying on gas to supply their heating and hot water, as well as a significant proportion of commercial buildings, heating buildings and industry represents an ever-greater proportion of UK emissions – 32% in 2015 [HM Government, "Clean Growth Strategy," October 2017].

In order for the UK to maintain a trajectory sufficient to meet the 2050 Paris Agreement decarbonisation target of an 80% reduction in annual greenhouse gas emissions over 1990 levels, focus must necessarily shift to other contributors. The BEIS Clean Growth Strategy provides an indication of the direction the UK's energy policy is likely to take and "…sets out [the government's] proposals for decarbonising all sectors of the UK economy through the 2020s." This includes investing in infrastructure and mechanisms to facilitate a transition to low emission vehicles and strengthening the energy performance requirements of new and existing buildings.

As engineers and specialists in the built environment, staying abreast of this dynamism across all sectors is essential for Hoare Lea.

Updates to the Standard Assessment Procedure (SAP10)

In July 2018, the Building Research Establishment (BRE) released an update to the Standard Assessment Procedure (SAP) – used to assess dwellings' compliance with Building Regulations – for consultation. The following represents a brief summary of the changes to carbon factors over the current methodology, SAP2012.

Carbon factors

Many of the fuel types recognised in SAP have had their fuel types, carbon factors and primary energy factors amended following the decarbonisation of the grid and other national infrastructure changes. The table below shows the changes in carbon factor from SAP2012 to SAP10 (July 2018). It is worth noting the significant improvement for the electricity carbon factor (almost half of that used in SAP 2012).

It is likely that that the next update to Building Regulations Part L will specify the SAP10 carbon factors associated with natural gas and electricity.

A very recent further update to the SAP10 carbon factors released by the BRE in October 2019 sees the grid electricity carbon factor fall even further. This change is so recent that reporting in this energy strategy has not incorporated this change.

Such a further reduction in the carbon factor for grid electricity would be expected to lead to even greater carbon savings for the Proposed Development, due to the electrically-driven strategy chosen.

Table 11: Current (SAP2012) and proposed (SAP10) carbon factors for natural gas and grid-supplied electricity.

Fuel	SAP2012 (Part L 2013) Carbon Factors ($kgCO_2/kWh$)	Draft SAP10 (July 2018) Carbon Factors ($kgCO_2/kWh$)	Draft SAP10 (Oct 2019) Carbon Factors ($kgCO_2/kWh$)
Main Gas	0.216	0.210	0.210
Electricity	0.519	0.233	0.136

Within London, the Greater London Authorities have issued planning guidance which confirm a preference for use of the SAP10 carbon factors since January of 2019. This has therefore already started to change energy strategies to move towards electrically driven systems.

Appendix 4: Comparison with other, recent, nearby schemes.

Comparisons are made here to the energy and sustainability strategy for other recent and similar nearby schemes. Information has been sourced from publicly available planning application documentation.

Bicester Motion

Development description
Hotel:

- 252 guest rooms
- 92 aparthotel suites

Associated gym, pool, bar, restaurant, conference and meeting rooms, to be built in two phases.

Energy & sustainability strategy overview
- Central plant room incorporating CHP
- No BREEAM target

Carbon reduction target
- Part L:
  - Be Lean: One phase estimated to be worse than Part L 'notional' building at this stage of the energy hierarchy
  - Be Green: Development as a whole estimated to achieve 20% reduction in carbon emissions (using Part L 2013 carbon factors)
- Total expected carbon emissions (using Part L 2013 factors) 56.8 kgCO_2/m^{2}yr (Phase 1); 57.2 kgCO_2/m^{2}yr (Phase 2)
- CIBSE TM54: No results

Comparison to Great Wolf Lodge
The scheme is similar in terms of use of the building to the Great Wolf Lodge, and therefore the mix of energy uses would be similar also, with a thermally led profile.

The development has not undertaken an operational energy assessment as part of the planning application, and therefore has not shown the same level of detail as the Great Wolf Lodge in assessing real expected energy consumption and carbon emissions.

The use of CHP shows carbon reductions only when using Part L 2013 carbon factors, which are known to be outdated in reality.

Therefore, although the carbon reduction is shown as 20%, and albeit we expect this was correct and based on the best available information at the time of that planning submission, the current reality is that implementation of CHP would no longer result in carbon emission reductions compared to a baseline scheme using just gas fired boilers.

The Great Wolf Lodge is expecting to achieve 39-45% carbon emission reductions depending on the methodology used (Part L or TM54) compared to a 'base scheme' energy strategy approach when using the 'current realistic' carbon factors set within the draft SAP 10 guidance. Even greater carbon emissions would be expected by use of very recent updated carbon factors issued on 10/10/2019 in a new draft of SAP 10.

When comparing total carbon emissions estimated from the Part L results like for like (i.e. comparison of Part L 2013 BRUKL results), it is noted that Bicester Motion is expected to emit 56.8 – 57.2 kgCO_2/m^{2}yr. The proposed holistic energy strategy for Great Wolf shows estimated carbon emissions of 52.7 kgCO_2/m^{2}yr – approx. 7-8% less than Bicester Motion, year on year.

Holiday Inn Express, Bicester Gateway

Development description
- Hotel: up to 149 rooms and associated works (from outline application description – precise description of detailed application was not located)

Energy & sustainability strategy overview
- Central plant room incorporating micro-CHP with gas boiler back-up for domestic hot water
- Heat pump heating and cooling to guest rooms (VRF system)
- BREEAM Very Good target

Carbon reduction target
- Part L: 11.2% reduction in carbon emissions (using Part L 2013 carbon factors)
- Total expected carbon emissions (using Part L 2013 factors) 61.9 kgCO_2/m^{2}yr
- CIBSE TM54: No results

Comparison to Great Wolf Lodge
The scheme is similar in terms of use of the building to the hotel areas of the proposed Great Wolf Lodge, and therefore the mix of energy uses would be similar also, with a thermally led profile.

The development has not undertaken an operational energy assessment as part of the planning application, and therefore has not shown the same level of detail as the Great Wolf Lodge in assessing real expected energy consumption and carbon emissions.

The use of CHP shows carbon reductions only when using Part L 2013 carbon factors, which are known to be outdated in reality. However, the use of heat pumps for heating and cooling would be expected to show better performance against Part L when using updated carbon factors. Therefore, over-all, the strategy might result in a similar performance with updated carbon factors, compared to the results given in the application.

When comparing total carbon emissions estimated from the Part L results like for like (i.e. comparison of Part L 2013 BRUKL results), it is noted that the Holiday Inn Express is expected to emit 61.9 kgCO_2/m^{2}yr. The proposed holistic energy strategy for Great Wolf shows estimated carbon emissions of 52.7 kgCO_2/m^{2}yr – almost 15% less than the Holiday Inn Express, year on year.

Premier Inn – Bicester: 57 bedroom extension

Development description
- Extension of 57 bedrooms to existing Premier Inn hotel

Energy & sustainability strategy overview
- No low or zero carbon technologies understood to be proposed
- BREEAM Very Good target

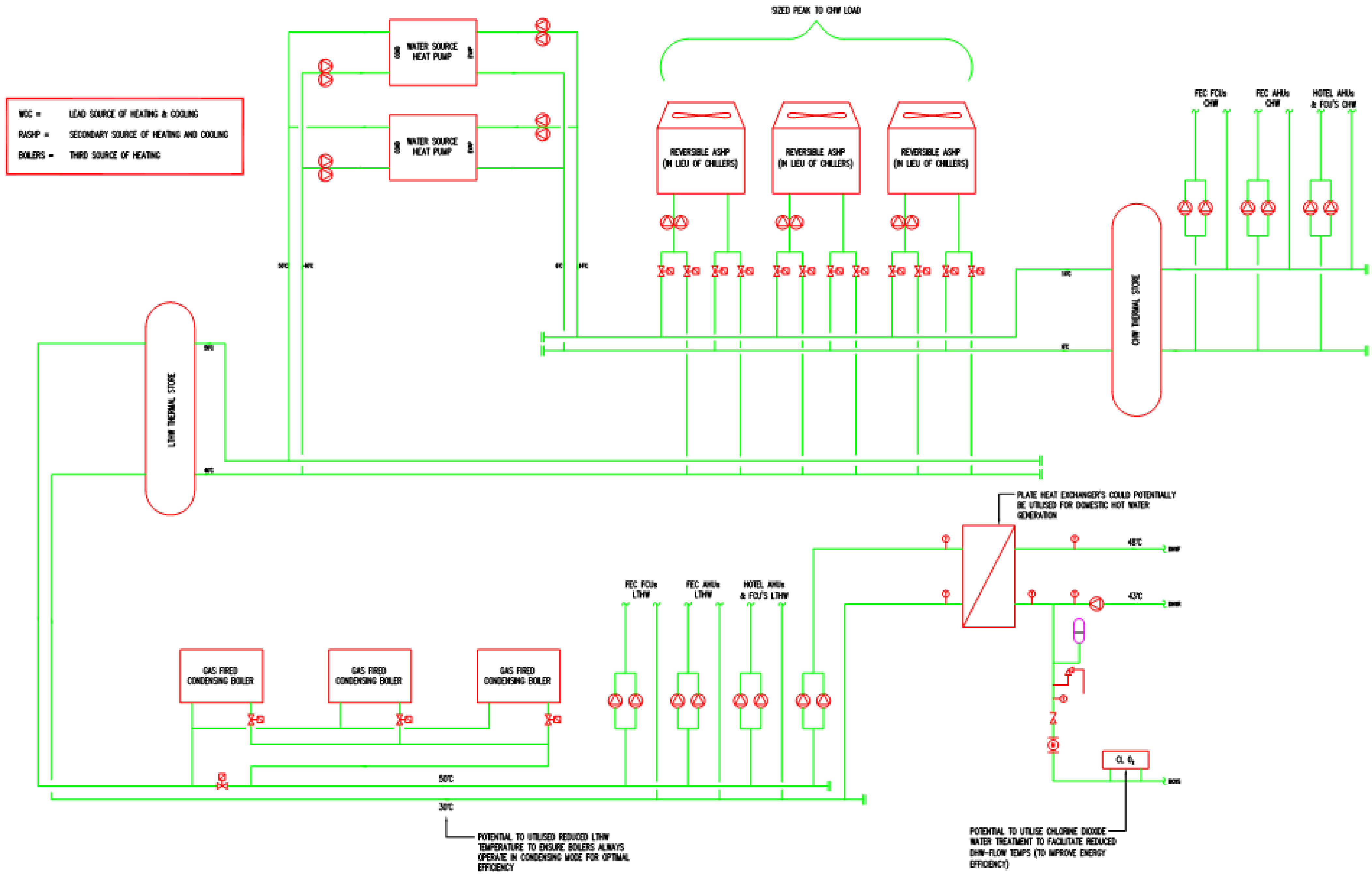
Carbon reduction target
- Part L: 11.1% reduction in carbon emissions (using Part L 2013 carbon factors)
- Total expected carbon emissions (using Part L 2013 factors) 71.1 kgCO_2/m^{2}yr
- CIBSE TM54: No results

Comparison to Great Wolf Lodge
The scheme is similar in terms of use of the building to the hotel areas of the proposed Great Wolf Lodge, and therefore the mix of energy uses would be similar also, with a thermally led profile.

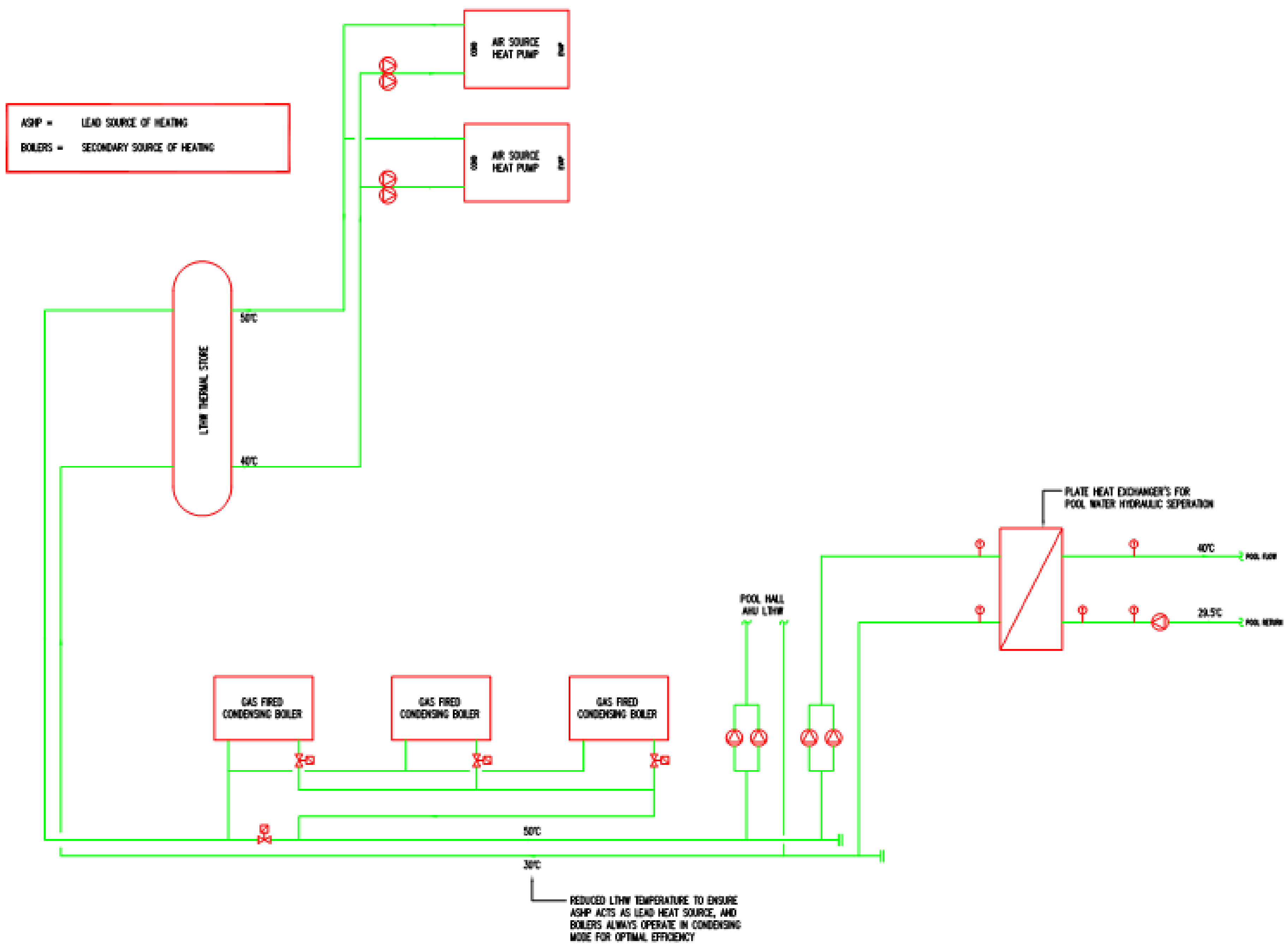
The development has not undertaken an operational energy assessment as part of the planning application, and therefore has not shown the same level of detail as the Great Wolf Lodge in assessing real expected energy consumption and carbon emissions.

When comparing total carbon emissions estimated from the Part L results like for like (i.e. comparison of Part L 2013 BRUKL results), it is noted that the Premier Inn extension is expected to emit 71.1 $kgCO_2/m^2yr$. The proposed holistic energy strategy for Great Wolf shows estimated carbon emissions of 52.7 $kgCO_2/m^2yr$ – almost 26% less than the Premier Inn extension, year on year.

Appendix 5A: Holistic energy strategy heating and cooling system concept schematic.



Appendix 5B: Water Park heating system concept schematic.



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